5-5-2012

Educational Prepardness of Entry-Level Athletic Trainers Regarding Preventing Sudden Death and Emergency Procedures

Thomas M. Yabor
University of Connecticut - Storrs, thomas.yabor@uconn.edu

Educational Preparedness of Entry-level Athletic Trainers Regarding Preventing Sudden Death and Emergency Procedures

Thomas McLean Yabor, ATC

B.S. West Chester University, 2010

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

At the University of Connecticut

2012

APPROVAL PAGE

Master of Science Thesis

Educational Preparedness of Entry-level Athletic Trainers Regarding Preventing Sudden Death and Emergency Procedures

Presented by

Thomas McLean Yabor, ATC

Co-Major Advisor ______________________________
Stephanie M. Mazerolle PhD, ATC

Co-Major Advisor ______________________________
Douglas J. Casa PhD, ATC, FACSM, FNATA

Associate Advisor ______________________________
Lindsay J. DiStefano PhD, ATC

University of Connecticut

2012

ACKKNOWLEDGEMENTS

This thesis is the culmination of my time at the University of Connecticut. There would not be a thesis if it wasn't for my professors Dr. Mazerolle, Dr. Casa and Dr. DiStefano. You all have helped me grow as a researcher and clinician and for that I am remarkably grateful.

Dr. Mazerolle, thank you for your guidance throughout the entire process, from inception to presentation there is no doubt that without your help I would not be able to complete this. I appreciate your patience during this process as I know I have tested it many times! Thank you for always keeping me on track.

Dr. Casa, thank you for always allowing me to speak my mind in class and always encouraging the expression of my viewpoints. You have taught me how to have an intelligent conversation which will, undoubtedly assist me in my professional and personal future.

Dr. DiStefano you came through for me in my time of need. Thank you for donating your time and effort to help me through this process.

The UConn Sports Medicine Family has been a pivotal part of these last two years; everyone has given me every opportunity to develop professionally and succeed. You all have contributed enormously to my development as a professional. Bob and Luke, I thank you for your incredible patience and mentorship. In the past two years I have learned more from both of you than I could have ever imagined. Because of your influence I have grown immensely, and for that I will be forever grateful.

To my parents none of this would be imaginable if it wasn't for you constant encouragement and positivity. You both are incredible role models for me and I can not ask for better parents, I love you both.

And finally to Brittany Miske, you have endured much over these last two years. Words can not describe how lucky I am to have you. You constant listening and encouragement helped me tremendously especially when things were difficult. Thank you for always being there for me, I love you.

TABLE OF CONTENTS

ABSTRACT

Educational Preparedness of Entry-Level Athletic Trainers Regarding Preventing Sudden Death in Sport

Yabor TM, Mazerolle SM, Salvatore AC, Pagnotta KD, DiStefano LJ, Casa DJ.
University of Connecticut, Storrs; CT.

Context: Sudden death is a constant concern in sport, in many cases the death is preventable. Athletic trainers (AT) need to be well-versed in the recognition and management of conditions that cause sudden death as they are often the first responder when these conditions occurs. Recent evidence regarding exertional heat stroke (EHS), a cause of sudden death, indicates a lack of educational training, not knowledge, as a factor contributing to the lack of implementation of best practices. **Objective:** Understand how athletic training education programs (ATEPs) prepare students to be competent in emergency care procedures. **Design:** An inductive qualitative study utilizing phone interviewing. **Setting:** Athletic Training Education Programs. **Patients or Other Participants:** An equal number of male and female senior athletic training students preparing to enter the workforce as ATs in the clinical setting, and recently graduated ATs in their first year of clinical practice (n=13, 7 males 6 females) (age: 23 $\pm$2 years). **Data Collection and Analysis:** One-on-one phone interviews following a semi-structured format were conducted with all participants. Demographic data were also collected prior to interviewing. Interviews were transcribed verbatim and shared with participants prior to analysis. The data were analyzed borrowing from the principles of a grounded theory approach and open coding. Multiple analyst triangulation and peer review were included as steps to establish data credibility. **Results:** One dominant theme emerged from the data to explain how ATEPs prepare their students to be competent regarding emergency care procedures: *compartmentalized.* The theme reflects the

participants' reflections that while they received the cognitive knowledge regarding sudden death in sport, they had minimal hands-on practice of those specific skills associated with the conditions pertaining to sudden death. The athletic training educators utilized traditional teaching methods, such as lecture and discourse, to relay the cognitive knowledge regarding sudden death in sport and laboratory time to provide practice time with basic skills, such as spineboarding and first aid. Also, athletic training educators tended to focus on conditions they had encountered versus the broader scope of conditions that may cause sudden death. However, when evaluating the student's ability to critically apply their knowledge and psychomotor skills, little real-life integration was used but rather more contrived, discussion-based instructional methods. This may limit the development of critical thinking and confidence with emergency care procedures.
Conclusions: Beyond providing the student with the necessary knowledge didactically and hands-on practice time through structured laboratory sessions, educators must also provide the chance for critical application of this knowledge and skills. Although case studies and simulations are important for initiation of application, students still must be forced, during these educational training sessions, to apply the skills as learned to be appropriate. Development of clinical competence is necessary regardless of the athletic training concept, but critical with sudden death in sport.

REVIEW OF LITERATURE

INTRODUCTION

Since 1982, 1866 sudden death events have occurred from participation in sport.[1] Of these sudden death events, 573 are categorized as "indirect injuries", meaning they are "caused by systemic failure as a result of exertion while participating in a sport or by a complication that was secondary to a non-fatal injury".[1] The predominant causes of death in these individuals have been identified as cardiac conditions, exertional heat illness, and exertional sickling, which can lead to acute rhabdomyolysis and asthma.[2] Other main causes of sudden death in sport are diabetes, head injury, cervical spine injury, hyponatremia, drowning, lightning strikes, and anaphylaxis.[2] Table 1 shows the top causes of sudden death and common scenarios and mistakes made when they occur.

Certified athletic trainers are allied health professionals, trained in the evaluation, diagnosis, and treatment of athletic injuries. Athletic trainers are also responsible for the overall healthcare of the athletic population. They are commonly the first responders when an injury takes place during sport. Because athletic trainers work so closely with athletes, it's important that they be familiar with the leading causes of sudden death in sport and know how to manage emergency situations.

To become a certified athletic trainer one must complete a baccalaureate degree, in an approved athletic training curriculum, and pass a national certification test. There are currently over 300 approved undergraduate programs in the country today. This large number can create a disparity between institutions regarding subject material and teaching methods.

Table 1 Top Causes of Sudden Death in Sport

Top Causes of Sudden Death in Sport			
Pathology	Common Scenario	Treatment	Common Mistakes
Cardiac	Basketball player suddenly collapses with no apparent contact	Activate EMS; Check ABCs; Begin CPR; use AED as soon as it becomes available	No AED; Unprompt EMS activation; No initiation of immediate CPR
Exertional Heat Stroke	Football player practicing in full pads on a hot humid summer afternoon in August	Assess core body temperature (rectal temperature); Immediate rapid cooling (cold water immersion); Monitor vitals; Cool first transport second	Not assesing core temperature; not using cold water immersion; Not initiating treatment quickly; not continuously circulating water
Asthma	Soccer player having difficulty breathing during a match	Administer rescue inhaler; Monitor vitals	No rescue inhaler; not knowing athlete has asthma
Anaphylaxis	Athlete is stung by a bee	Aid patient in administration of epi-pen; activate EMS; maitain airway	No epi-pen; No EMS activation
Head Injury	Baseball pitcher hit in head by a ball	Remove from acitivity; Cognitive and physical assessment; Monitor vitals; Monitor symptoms; Gradual return to player when asymptomatic	Return to play too soon; Not recognizing symptoms; Treating symptoms too lightly
Sickling	African-American player collapses while running conditioning sprints	Remove from activity; administer oxygen; hydrate; cool if necessary	Misdiagnosed with heat or cardiovascular collaspse; No intervention
Diabetes	Diabetic athlete shows signs of cognitive distress, and decreased responsiveness	Assess vitals; determine hyper/hypo-glycemia (blood glucose level); Moniotr vitals; administer glucose;	No diabetes kit; Unaware athlete has diabetes; Confusing hyper and hypo glycemia

Hyponatremia	Marathon runner collapses 25 yd. from finish line	Assess vitals; Check Na levels; Check core temperature; restrict fluids; administer hypertonic saline if hyponatremia is severe (Na levels must be measured	Administer fluids;
Lightning	Lacrosse player struck by lightning	Activate EMS; Move victim to safe place; Monitor vitals; Initiate CPR; treat in a "reverse triage" strategy	Continue to play; Not utilizing flash-to-bang; Not using 30/30 rule
C-Spine	Football player tackling with head down	Stabilize and maintain neck in neutral position; Activate EMS; Monitor vitals (Remove facemask in sports requiring the use of helmet); Secure to spine board (if appropriate personal available)	Improper stabilization; excessive motion; not monitoring vitalsl; removal of helmet
Traumatic Injury	Soccer player getting kicked in the abdomen	Thorough abdominal evaluation (location of pain, referred pain, local or diffuse pain); EMS activation; keep player in recumbent position until EMS arrives	Not suspecting abdominal trauma (internal bleeding)

Created by Yabor, Adams, McGrath, Salvatore

Because of the nature of athletic training, it is important that the entry-level clinicians are adequately prepared to practice as an athletic trainer, which may involve a case in which sudden death occurs. Due to this our study set forth to examine how entry-level athletic trainers are prepared through their undergraduate education to prevent sudden death in sport, and manage an emergency situation should one arise.

OVERVIEW

Cardiac conditions include an array of different pathologies. In particular hypertrophic cardiomyopathy, a congenital disease where the left ventricular wall thickens, has been described to cause majority of deaths. Maron identifies nine specific cardiac pathologies that have caused sudden death of athlete (Table 2), forty-four percent of these cardiac pathologies have been identified as hypertrophic cardiomyopathy.[3]

Exertional heat illness categorizes many associated pathologies including heat cramps, heat syncope, exertional heat exhaustion, and exertional heat stroke. Of the pathologies, only exertional heat stroke (EHS) is fatal. EHS is usually associated with elevation of core body temperature and decreased central nervous system function, which can lead to organ failure. These pathologies are most often, but not always, sustained in hot and humid environments while performing intense, vigorous exercise.

Exertional sickling is a condition that may arise when an athlete has sickle cell trait. In certain conditions an athlete with sickle cell trait can experience ischemic rhabdomyolysis, which is the rapid breakdown of muscles that are starved of blood.

Table 2. Causes of Death in 690 Confirmed Cardiovascular Cases

Cause	No. of Athletes	Percent
Hypertrophic Cardiomyopathy*	308	44
Coronary artery abnormalities	119	17
Myocarditis	41	6
Arrhythogenic right ventricular cardiomyopathy	30	4
Mitral valve prolapse	24	3
Coronary artery disease	23	3
Ruptured aortic aneurysm (Marfan's syndrome)	19	3
Aortic-valve stenosis	17	2
Dilated cardiomyopathy	14	2
Other Cardiac Pathologies	95	14
Commotio Cordis**	65	

*HCM includes cases of possible HCM (n=57) in which the diagnosis was not definitive but possible

**Commotio Cordis is not a cardiovascular pathology

Adapted from Maron *Circulation* 2009;119:8 1085-92

Asthma is defined as chronic variable airway obstruction and bronchial hyperresponsiveness. If immediate treatment with a fast acting inhaler is not administered, this condition can become fatal in minutes.

Diabetes mellitus is a condition affecting the blood glucose levels in patients, which can lead to failure of various organs, such as the eyes, heart, kidneys and nerves.[4] This disease is categorized by the inability to control blood glucose levels, weather too high (hyperglycemic) or too low (hypoglycemic).

Head injuries are very common in sport, especially in sports such as hockey, football, cycling, and lacrosse. In regards to sudden death, head injuries encompass an array of pathologies ranging from concussions to skull fractures. These pathologies occur when the head is subject to accelerating forces caused by a hit or fall. With concussions two specific conditions arise with regards to sudden death, subdural and epidural hematomas.

Epidural hematomas occur when blood pools between the dura mater of the brain and the skull. A subdural hematoma occurs when blood pools below the dura mater. The onset of an epidural hematoma manifests more quickly than a subdural hematoma.

Also associated with concussions is second impact syndrome, which is defined as a subsequent impact to the head in the absence of a hematoma, which causes rapid and profound swelling of the brain.[5] Guidelines have been set forth by many organizations and panels;[6, 7] however, the body of knowledge grows everyday, therefore conservative treatment and return to play guidelines are practiced by many certified athletic trainers.

Cervical spine injuries occur in many facets of everyday life. It is estimated that approximately 12,000 new cases of spinal cord injury arise each year in the United States alone.[8] According to the National Spinal Cord Injury Statistical Center (NSCISC), sport constitutes 7.9% of all spinal cord injuries.[9]

Hyponatremia is a condition defined as serum-sodium levels less than 130mmol/L.[10] This pathology is usually suspected when activity takes place over long periods of time, usually exceeding 4 hours. Hyponatremia is categorized by central nervous system (CNS) dysfunction, including, but not limited to, disorientation, headache, vomiting, and altered mental status.

In a study by Harris et al. examining USA Triathlon sanctioned events between 2006 and 2008, it was found that 13(93%) deaths occurred during the swimming portion of the triathlon. Drowning was declared the cause of each death.[11] Other than triathlons, drowning can happen in various other sports such as, swimming and diving, or any sports in which swimming may be used as a type of conditioning not just as competition.

Lightning kills approximately 100 people per year.[12] The prevalence of thunderstorms is increased during the afternoon to early evening hours during the late spring to early fall. This time coincides with a majority of outdoor sport activities. Lightning deaths are easily preventable by using sound knowledge of the flash-to-bang recommendations by the NATA, as well as recommendations in the event shelter cannot be taken. Flash-to-bang is a mode by which you can distinguish the proximity of a lightning strike. By counting the number of seconds between the flash of light and sound of thunder and dividing those seconds by five will give an approximation of the lightning strike in miles. The recommendation set forth by the NATA is that all activities cease when lightning is within six miles (30 seconds) and activity should not resume until 30 minutes after the last lightning strike.

Anaphylaxis is an allergic reaction in which a person's life can be in jeopardy. Many irritants can cause anaphylaxis, however the onset and treatment remain the same throughout. When a patient experiences anaphylaxis the immediate treatment in an epinephrine auto injection via what is commonly referred to as an "epi-pen". Epinephrine is only an initial treatment; all patients experiencing anaphylaxis should be immediately transported to an emergency department for further treatment.

All of these pathologies are capable of causing sudden death in sport; however, some pathologies are more prevalent than others. Because of this disparity, the focus will be on the leading four causes of sudden death in sport which are cardiac conditions, exertional heat stroke, acute rhabdomyolysis due to exertional sickling, and asthma.[2]

CARDIAC CONDITIONS

Cardiac conditions that cause death are grouped into four subtypes 1) congential defects, which mainly plague younger individuals 2) heart disease which normally affects an older population 3) commotio cordis which affects primarily adolescents and 4) myocarditis which is an inflammation of the heart.

Epidemiology

Utilizing data from the National Center for Catastrophic Sport Injury Research Maron et al. determined of 1866 sudden death events, occurring from 1980-2006, 1049 were judged to be definitely or probably due to cardiovascular issues In a study conducted by Harmon et. al, the incidence rate of the sudden cardiac death was 1:43,770.[13] Between 2001-2006 there was a yearly average of 66 cardiovascular deaths that occurred in sport. In a review of 387 cases of sudden death in sport, Maron identified 102(26.4%) cases in which hypertrophic cardiomyopathy (HCM) was the primary cause of death.[14] This figure is reiterated in Maron's 2009 study in which 308(44%) of all cardiovascular cases of sudden death were attributed to hypertrophic cardiomyopathy.[3] In a 2003 study, published in the *New England Journal of Medicine*, Maron stated the second leading cause of sudden death in young athletes to commotio cordis.[14] Although HCM and commotio cordis are the leading causes of sudden death in sport, various other cardiovascular conditions have been identified to cause sudden death in sport, including but not limited to, coronary artery abnormalities, myocarditis, and ruptured aortic aneurysm which occurs when a patient has Marfan's syndrome.

Hypertrophic cardiomyopathy is a heterogeneous myocardial disorder with a broad spectrum of clinical presentation and morphologic features.[15] HCM occurs with an incidence of 1 in 500 persons in the general population[16] and is defined as an asymmetrically hypertrophied and nondilated left ventricle.[14] In patients with HCM the increased thickness of the left ventricular wall decreases the volume of the left ventricle. This decrease in volume subsequently causes a decrease in cardiac output and forces the heart to beat more than a heart with normal ventricle wall thickness. In cases where HCM is suspected, a sudden collapse of an athlete with no apparent contact is usually noted. The actual cause of death in patients with HCM is a consequence of an electrically unstable and unpredictable myocardial substrate with reentrant ventricular tachyarrhythmias.[14]

Commotio cordis is not a cardiovascular disease, but a product of blunt force trauma to the chest causing ventricular fibrillation without structural injury to the ribs, sternum or heart.[17] Commotio cordis occurs predominantly in children and adolescent populations presumably because this population's chest wall is compliant thus able to facilitate transmission of energy from the chest blow to the myocardium.[17, 18] The actual cause of death occurs when a blunt force trauma occurs at the chest, in sport this can be by a baseball, hockey puck, and in some cases a person in the form of a karate chop or punch. This trauma must happen within 15-30 msec before the T-wave peak during the vulnerable time of repolarization.[17] The time frame for this injury is about 1% of the total cardiac cycle.

Coronary artery abnormalities refer to congenital cardiovascular disease affecting the arteries of the myocardium. Maron identified this as the second leading cardiovascular cause of death.[3] Most commonly the coronary artery is of the wrong sinus origin coursing between the aorta and pulmonary trunk[3].[3]

Myocarditis is the inflammation of the heart due to an infection. Myocarditis is associated with a host of pathologies that may not directly cause death, however the heart, in this weakened state, is more susceptible to failure.

Prevention

Prevention of sudden cardiac death begins before an athlete steps foot on a playing field of any sort. The pre-participation examination is the first line of defense in diagnosing those with possible cardiovascular abnormalities. A pre-participation exam (PPE) consists of history taking and a physical exam in which a doctor must clear a patient for participation in athletics. However, even with implementation of PPEs Maron et al. have identified problems with current practices.[14]

Firstly, it has been substantiated that some states' legislation allow healthcare workers with different levels of training (e.g. chiropractors, podiatrists) to perform a PPE. In these areas athletic programs should mandate that only licensed medical physicians (M.D. or D.O.) perform these examinations. Secondly, Maron states that the guidelines given for screening high-school athletes are inadequate in 40% of states when measured against the American Heart Association. Some questions omitted, for example, are history of exertional chest pain, excessive dyspnea, family history of heart disease, or heart murmur.

Maron suggests the United States moves towards what the Italian legislative body has mandated through their Medical Protection of Athletic Activities Act[19] This law mandates the use of history taking, physical examination, as well as a 12-lead electrocardiogram. The use of the electrocardiogram is essential because in up to 95% of patients with HCM the electrocardiogram is abnormal.[19] Maron identifies that these screening tools may not be practical over the entire country, as well as addresses the fact the use of these tools does not completely prevent sudden cardiac arrest, but can be helpful in identifying at risk participants.

It's also understood that even with PPEs in place, situations may arise in which a stimulus can cause sudden cardiac arrest (e.g. commotio cordis). Therefore, it is imperative that those who are responsible of the health and welfare of these athletes understand how to recognize and treat these different pathologies.

Recognition and Treatment

Because of the prevalence of cardiac arrest as a cause of sudden death, many certified athletic trainers will immediately assume a cardiac pathology when an athlete collapses. The Board of Certification (BOC), the certifying entity for athletic trainers, mandates that to be certified as an athletic trainer, the person must maintain current certification in cardiopulmonary resuscitation (CPR) and automated external defibrillators (AED). The National Collegiate Athletic Association also mandates that all of those affiliated with the sports medicine staff (i.e. certified athletic trainers, athletic training students, student workers) hold current CPR and AED certifications.

When a cardiac pathology arises, the site specific emergency action plan (EAP) should be initiated immediately. The need for emergency medical services is of utmost importance, therefore the NATA recommend that all athletic trainers and associated emergency medical personnel rehearse their EAP yearly.[20] Once EMS is activated the treatment of cardiac arrest is dependent on the presence of a pulse. If a pulse is not present cardiopulmonary resuscitation is to begin immediately. If an AED is readily available the AED pads should be place on the patient before CPR is initiated. If a pulse is present, but irregular, an AED should be immediately be placed on the individual in order to restore normal heart rhythm.

Other than a trained person, the only tool needed is an automated external defibrillator unit. Each AED initially costs approximately $1,000, when compared to the costs of operating athletic programs, is minimal. The NATA issued an official statement in 2003 stating, among other things, "Athletic trainers are encouraged to make an AED part of their standard emergency equipment".[21] Therefore all athletic trainers need to be vocal about the need for access to AEDs at all sporting venues.

Return to Play

When an athlete is diagnosed with a cardiac abnormality there are certain guidelines in place to protect the athlete. The 36th Bethesda Conference recommends each case be thoroughly evaluated by a specialized physician and decisions made on a case-by-case basis.[22] The conference conservative management when allowing return to play, because of the nature of cardiac pathologies and possible repercussions involved.

EXERTIONAL HEAT STROKE

Since 2000, 29 athletes have died from exertional heat illness.[1, 23] These deaths are 100% preventable when this pathology is recognized and treatment is initiated within 10 minutes.

Epidemiology

Exertional heat stroke (EHS) is characterized by an elevated core body temperature of greater than 105°F, associated with the signs of organ failure and central nervous system dysfunction due to hyperthermia.[2, 10, 24] EHS occurs most frequently in hot-humid conditions, but can occur in cool conditions as well.[10, 24] Exertional heat stroke should not be confused, or used interchangeably with traditional heat stroke. Traditional heat stroke occurs when a person is subject to high temperatures over an extended period of time. Situations where traditional heat stroke may occur include an elderly person in a house with no air conditioning in the summer or someone in a hot car with no ventilation for an extended amount of time. Where as, exertional heat stroke is occurs when a body is subject to intense exercise and the body's thermoregulatory system is compromised. With thermoregulation compromised, the body is unable to dissipate heat to the surrounding environment that causes an increase in core body temperature.

Incidence rates for EHS are skewed because EHS does not always have a fatal outcome. Fatal EHS is a rare event that strikes at random in sports like American football, especially during the first four days of preseason conditioning, where the incidence of fatal EHS was about 1 in 350,000 participants from 1995 to 2002.[24, 25]

Football players are not the only population that may fall victim to EHS, road racing and other activities that involve continuous, high intensity exercise have been shown to have a high occurrence of EHS. In one road race measuring 7mi(11.5km), run during the hot-humid summer months, averages 10-20 cases of EHS per 10,000 entrants.[24] Casa et al. state that when proper recognition and treatment are utilized within the 10 minutes of identifying an exertional heat stroke, there is a 100% survival rate.[26] Many EHS victims that are properly cared for, in a timely fashion, will not even warrant an overnight stay in a hospital. Despite this survival rate, athletes throughout the country are still dying due to this pathology because of improper recognition and immediate care.

Prevention

Prevention of EHS is a multi-faceted approach consisting of monitoring the temperature, time of exercise, intensity of exercise, along with athlete's hydration status, and mental status. Predisposing factors have been identified in order to aid clinicians in identifying individuals who may be at risk for suffering from EHS.[27, 28] Rav-Acha et al. compared 6 fatal EHS cases to non-fatal cases and developed a table to compare the two groups (Table 3). Physiologic risk factors include underlying illness, which may cause an athlete to begin exercise with an already elevated core body temperature, low level of physical fitness, which is normally the case in the first few days of preseason conditioning, dehydration, sleep deprivation, being overweight, and improper acclimatization. Along with the physiologic risk factors, environmental risk factors were also identified.

Table 3. Predisposing factors for heat stroke in six fatal cases (compared with nonfatal cases)

Predisposing factor	Patient 1	2	3	4	5	6	Total	Nonfatal, % (N)
Physiologic individual limitations								
Underlying illness	+	-	+	-	+	-	3/6	17.9 (21/117)
Low physical fitness	+	-	+	+	+	+	5/6	71 (66/93)
Dehydration	-	+	+	-	-	-	2/6	21.4 (19/89)
Sleep deprivation	+	+	-	+	+	+	5/6	40.3 (29/72)
Overweight	+	+	-	+	-	-	3/6	64.7 (68/105)
Improper acclimatization	+	-	-	+	+	+	4/6	13.7 (13/95)
Total background factors	5	3	3	4	3			
Environmental factors								
Heat load corresponding to green flag or above (WBGT ≥ 27°C)	+	-	+	+	+	+	5/6	16.5 (17/103)
High solar radiation	+	+	+	-	+	+	5/6	28 (35/125)
Organizational factors								
Physical effort unmatched to physical fitness	+	+	+	+	+	+	6/6	21.6 (23/106)
Improper work/rest cycles	+	+	-	-	+	+	4/6	23.8 (20/84)
Improper rehydration regimen	+	+	+	-	-	-	3/6	16.4 (14/85)
Absence of proper medical triage	+	+	+	+	+	+	6/6	15 (18/120)
Training at hottest hours	+	+	+	-	+	+	5/6	35 (42/120)
Disregarding regulations	5	5	4	2	4	4		
Treatment factors								
Improper diagnosis	+	+	-	+	-	-	3/6	21.2 (20/95)
Improper treatment	+	+	+	+	-	-	4/6	15.1 (15/99)
Total risk factors	14	11	10	9	10	9		

WBGT—wet bulb globe temperature.
(Data from Rav-Acha et al. [5••]; with permission.)

Taken from Casa et al.[27, 28]

These environmental risk factors include wet-blub globe temperature (WBGT) of greater than 27°C(81°F) and high solar radiation. The WBGT and solar radiation values are commonly highest during the afternoon hours, when athletic events are commonly held. Due to the extensiveness of all risk factors both the NATA and ACSM have issued position statements, which include recommendations for clinicians on preventing, recognizing and treating exertional heat illnesses. These documented have synthesized the most current research on exertional heat illnesses and aid clinicians in forming protocols in regards to exertional heat illness management. Table 4 is an example of a checklist that can be used by clinicians in order to be sure they are not predisposing athlete to suffer an exertional heat stroke.[10]

Table 4: EHS Prevention Checklist

Prevention Checklist for the Certified Athletic Trainer*
1. Pre-event preparation
Am I challenging unsafe rules (eg, ability to receive fluids, modify game and practice times)?
Am I encouraging athletes to drink before the onset of thirst and to be well hydrated at the start of activity?
Am I familiar with which athletes have a history of a heat illness?
Am I discouraging alcohol, caffeine, and drug use?
Am I encouraging proper conditioning and acclimatization procedures?
2. Checking hydration status
Do I know the pre-exercise weight of the athletes (especially those at high risk) with whom I work, particularly during hot and humid conditions?
Are the athletes familiar with how to assess urine color? Is a urine color chart accessible?
Do the athletes know their sweat rates and, therefore, know how much to drink during exercise?
Is a refractometer or urine color chart present to provide additional information regarding hydration status in high-risk athletes when baseline body weights are checked?
3. Environmental assessment
Am I regularly checking the wet-bulb globe temperature or temperature and humidity during the day?
Am I knowledgeable about the risk categories of a heat illness based on the environmental conditions?
Are alternate plans made in case risky conditions force rescheduling of events or practices?
4. Coaches' and athletes' responsibilities
Are coaches and athletes educated about the signs and symptoms of heat illnesses?

Am I double checking to make sure coaches are allowing ample rest and rehydration breaks?

Are modifications being made to reduce risk in the heat (eg, decrease intensity, change practice times, allow more frequent breaks, eliminate double sessions, reduce or change equipment or clothing requirements, etc)?

Are rapid weight-loss practices in weight-class sports adamantly disallowed?

5. Event management

Have I checked to make sure proper amounts of fluids will be available and accessible?

Are carbohydrate-electrolyte drinks available at events and practices (especially during twice-a-day practices and those that last longer Than 50 to 60 minutes or are extremely intense in nature)?

Am I aware of the factors that may increase the likelihood of a heat illness?

Am I promptly rehydrating athletes to pre-exercise weight after an exercise session?

Are shaded or indoor areas used for practices or breaks when possible to minimize thermal strain?

6. Treatment considerations

Am I familiar with the most common early signs and symptoms of heat illnesses?

Do I have the proper field equipment and skills to assess a heat illness?

Is an emergency plan in place in case an immediate evacuation is needed?

Is a kiddy pool available in situations of high risk to initiate immediate cold-water immersion of heat-stroke patients?

Are ice bags available for immediate cooling when cold-water immersion is not possible?

Have shaded, air-conditioned, and cool areas been identified to use when athletes need to cool down, recover, or receive treatment?

Are fans available to assist evaporation when cooling?

Am I properly equipped to assess high core temperature (ie, rectal thermometer)?

7. Other situation-specific considerations

Taken from Binkley et al. [10]

Both the ACSM and NATA recommend an acclimatization period of 10-14 days in order to properly acclimatize the athletes to physical exertion in hot-humid conditions. It is noted that exercise intensity should gradually increase from day to day. [10, 24] The National Collegiate Athletic Association (NCAA) has followed suit mandating a five-day acclimatization period, for football programs, in which participants may only wear helmets on days 1 and 2, helmets and shoulder pads on days 3 and 4 and full pads on day 5. (NCAA By-law 17.11.2.3[29]) The NATA has also issued a consensus statement regarding an acclimatization period for secondary schools. These recommendations mimic the NCAA, in regards to a gradual increase in intensity and equipment. However the consensus statement does not limit itself to football like the NCAA by-laws. The NATA consensus statement says, "These guidelines should be used for all preseason conditioning, training, and practice activities in a warm or hot environment, whether these activities are conducted indoors or outdoors".[30] Even with this mandatory acclimatization period, athletic trainers should note that EHS could still occur during any practice.

In conjunction with an acclimatization period the NATA recommends appropriate medical care be available and that rescue personnel (ATCs, EMTs, physicians) be familiar with the prevention, recognition, and treatment of exertional heat illness. This recommendation requires sports medicine staff and corresponding emergency medical services (EMS) to work together in order to provide the best medical care possible for the athletes. In order to achieve this, sports medicine staffs and EMS need to have rehearsed EAPs as well as standard protocols in place when a case of EHS is sustained.

Education is also stressed in both the NATA and ACSM position statements because many of the people who participate in athletics (coaches, athletes, various staff members) do not fully understand EHS. Education should involve the signs and symptoms of EHI, risks associated with exercising in hot-humid environments, as well as proper fluid intake.

In order to thoroughly address proper fluid intake the NATA issued a position statement on *Proper Fluid Replacement for Athletes.*[31] In this document the recommendations begin before athletic performance takes place, by stressing the importance of being euhydrated at the beginning of practice. To accomplish this it's recommended that each athlete consume 500-600mL(17-20oz.) of water or sports drinks 2-3 hours before exercises and 200-300mL(7 to 10oz.) 10 to 20 minutes before exercise. During exercise it is recommended that fluids be easily accessible as well as made as palatable as possible (e.g. flavored or cold, between 50° and 59°F) in order to encourage drinking. If possible, individual bottles, or other hydration systems are also recommended because they encourage greater fluid volume ingestion.

Post practice hydration is also important to rehydrate athlete and prepare them for future exercise bouts. Rehydration is recommended to take place within 2 hours of cessation of exercise, and should include water to restore hydration status, carbohydrates to replenish glycogen stores, and electrolytes to speed rehydration. Education of the athletes, coaches, athletic trainers, and physicians is also stressed to encourage a team effort in maintain hydrations status.

Proper sleep and a well balanced diet are also addressed in the *NATA Position Statement: Exertional Heat Illnesses.* Six to eight hours of sleep per night is recommended in order to aid in recovery between bouts of exercise. Also a well balanced diet following the Food Guide Pyramid and United States Dietary Guidelines, it is noted that an athlete exercising in hot conditions require extra sodium in their diets. Eating foods that contain larger amounts of sodium such as lunchmeat, chips, or pretzels, as well as adding salt to other foods can easily attain this extra sodium. On top of hydration, dietary, and lifestyle recommendations, the NATA also addresses environmental concerns regarding exercise in the heat.

The NATA advocates the use of a WBGT as the preferred measurement of hot-humid environments. A table (Table 5) has been established and is recommended for use by clinicians. This table identifies different levels of risk and provides recommendations for activity modification. Activity modification is important because it results in decreased exercise intensity, and will aid in preventing core body temperature from becoming dangerously high. When the WBGT is less than 75°F the level of risk is low, however clinicians still need to be aware that a case of EHS may still occur. Between 75-78.6°F there is moderate risk and the risk level increases throughout the day. In these conditions clinicians should be more alert for the early warning signs that an athlete may be sustaining an EHS event. From 78-84°F there is high risk and everyone should be aware of the injury potential. Those individuals that have been identified as "at risk" should not compete. WBGT above 85°F warrant extreme risk and if possible the event (practice or competition) should be delayed until temperatures cool. If postponement of the event is not possible, then clinicians should be on high alert and be ready to implement the proper protocol if an EHS occurs.

Table 5: Activity categories based on environmental stress

WBGT		
°F	°C	Restraints on Activities
<75.0	<24.0	All activities allowed, but be alert for prodromes of heat-related illness in prolonged events
75.0–78.6	24.0–25.9	Longer rest periods in the shade; enforce drinking every 15 min
79.0–84.0	26.0–29.0	Stop activity of unacclimatized persons and high-risk persons; limit activities of all others (disallow long-distance races, cut the duration of other activities)
>85.0	>29.0	Cancel all athletic activities

Notes:
1. Source: reference (7).
2. These guidelines do not account for clothing. Although the effects of the uniform clothing and protective equipment (i.e., American football) on sweating and body temperature in younger athletes are unknown, uniforms should be considered when determining playing/practice limitations based on the WBGT.
3. Eight to 10 practices are recommended for heat acclimatization (30–45 min each; one per day or one every other day).
4. Differences of local climate and individual heat acclimatization status may allow activity at higher levels than outlined in the table, but athletes and coaches should consult with sports medicine staff and should be cautious when exceeding these limits.

Taken from Armstrong et al.[24]

One aspect of sport that contributes to thermoregulation is equipment. The more equipment that an athlete wears the more difficult it is to dissipate body heat through radiation, convection, and evaporation. One sport where this is evident is American football, according to Armstrong et al. the regulation pads and helmet for football players covers approximately 50% of the body with another 20% being covered by additional clothing.[32] Because of this decrease in area available for heat dissipation, it is important for clinicians, in conjunction with coaching staffs, to work out a plan in order allow the athletes to decrease the amount of padding worn during particularly hot events

Recognition

Early recognition and prompt treatment are crucial for saving the lives of patients that fall victim to EHS. Initial signs and symptoms, which may lead you to suspect EHS is markedly altered cognitive function. This includes, but is not limited to, irrational behavior, dizziness, emotional instability, aggressiveness, disorientation, and loss of consciousness or coma. These signs should then lead a clinician to further assess the patient by obtaining an accurate core body temperature assessment.

Many different modes of temperature assessment have been identified in past years. These modes include oral, axillary, temporal, aural, gastrointestinal, esophageal, as well as rectal. The NATA and ACSM both advocate the use of rectal temperature in accurately assessing core body temperature. Casa et al. conducted a study comparing different methods of assessing body temperature.[26] In this study oral, axillary, gastrointestinal, forehead, temporal, and rectal temperature were compared. This study concluded that when compared to rectal temperature, only gastrointestinal was valid. Craig et al. performed a systemic review comparing temperature measured at the axilla compared with rectum in children and young people.[33] This review concluded that there were wide variations between temperature readings from the axilla and rectum. Because of these disparities, in emergency situations, rectal temperature is considered the gold standard.

Treatment

It is widely accepted that the main predictor of outcome in EHS is the duration and degree of hyperthermia.[34, 35] Any delay in or absence of treatment could prove fatal.[27] Many different methods have been proposed throughout the literature including cold-water immersion, tepid water immersion, massage with ice bags, ice towels, and fanning of the body.[36] Because the goal is to lower the body's temperature as rapidly as possible both the NATA and ACSM have supported the use of cold-water immersion as the gold standard of treatment of EHS.

To properly perform cold-water immersion, the NATA has recommended that the water be between 35-59°F and excess equipment and clothing should be removed. The trunk and extremities should be completely submerged and water circulated to facilitate cooling, while monitoring core body temperature and vital signs at 5-10 minute intervals. Cooling should continue until core body temperature reaches 102°F. If a physician is present EMS need not be activated, however in the event a physician is not present EMS should be activated immediately.

Return to Play

Currently no evidence-based recommendations exist regarding return to exercise after an EHS episode.[24] Five current recommendations for return to play after EHS are refraining from exercise for at least seven days following being released by medical care, have a follow up physician exam, when cleared for return to activity start in a cold environment and gradually return to full participation, if athlete is having difficulty returning to play administer a laboratory exercise heat tolerance test, team physicians can usually clear the athlete after roughly 2-4 weeks of training if heat tolerance exists.

ACUTE RHABDOMYOLYSIS DUE TO EXERTIONAL SICKLING

Epidemiology

Since 2000, 16 deaths have occurred in NCAA Division 1 football players.[37] All of these deaths occurred during some type of conditioning, either weight lifting (1) or high speed agility drill (15). Of these deaths, 10(63%) are attributed to complications due to exertional sickling.

Sickle cell trait (SCT) is characterized by the inheritance of a normal hemoglobin gene and a mutated beta1-globin gene, the sickle hemoglobin gene. SCT is found in approximately 300 million people with concentrations in Africa, the Arabian Peninsula, India, the Mediterranean, and southern United States.[38] It's estimated that 3 to 4% of all NCAA Division 1 football players have sickle cell trait.

In athletes with SCT strenuous exercise can foster a change in red blood cell (RBC) shape from round to a quarter-moon or "sickle".[39] This change in RBC shape can cause a "logjam" effect, thus depriving the muscles of oxygen. This oxygen starvation leads to ischemia and consequently acute rhabdomyolysis. This muscle death can cause a host of pathologies; most frequently systemic hyperkalemia, which will cause cardiac arrest or renal failure, and subsequently death.

Further evaluation of the 10 deaths due to exertional sickling shows that each athlete was participating in intense exercise, five had been doing serial sprints, four intense multi station drills with no rest and one was running cross field sprints, also known as "gassers", for thirty minutes. Due to this commonality, Eichner coins sickling collapse as an "intensity syndrome".

Prevention

In 2010, the NCAA Division 1 Legislative Council mandated that all incoming Division 1 student athletes must be tested for sickle cell trait, show proof of a prior test, or sign a waiver releasing an institution from liability if they deny a test. The NATA recommends that all athletes confirm their sickle cell status in their pre-participation physical examinations.[40] In the United States all newborns are screened at birth for this trait, and it should be made known to the patient, their parents, and their healthcare provider.

Athletes with SCT should not be excluded from participation in sport, however precautions and modifications should be made in regards to conditioning.[40] Recommendations made by the NATA to aid in the prevention of exertional sickling include building slowly in training with paced progressions allowing for longer rest and recovery periods. Also year round training in order to enhance the preparedness for sport-specific performance tests. Athletes with SCT should be withheld from performance tests such as mile runs, serial sprints, etc., as several deaths have occurred during these activities, as well as ceasing activity with onset of symptoms, which include muscle cramping, muscle weakness, and tenderness.

Environmental concerns also contribute to the onset of exertional sickling. Increased ambient heat stress, asthma, illness, altitude, and dehydration have been identified as predisposing an athlete with SCT to a crisis onset. It is recommended that work/rest cycles be adjusted with the heat stress. Hydration should be emphasized in accordance with the NATA *Position Statement: Fluid replacement for athletes.* Proper hydration is important because it has been proposed that dehydration contributes to the sickling of capillaries in muscles. Asthma control and keeping an athlete that is ill are also identified as contributors to exertional sickling. A change in altitude is also an identifiable risk factor for exertional sickling.

An athlete that normally trains at lower altitude may develop exertional sickling symptoms when they participate in physical activity at high altitudes. An example of this is a college, team that normally trains at sea level, traveling to Denver, CO where the elevation is a mile above sea level. The abrupt change in altitude does not allow for proper acclimatization, in which the volume of red blood cells increases. This change occurs over several weeks, therefore initially the RBC encounter increased strain in order to trigger the adaptation. The increased RBC strain in athlete with SCT can prove too much and cause the RBC to sickle. Educating the athlete, their families, as well as coaches and those supervising activities is crucial to preventing exertional sickling. An environment that encourages the athlete with SCT to report any symptoms should be fostered. In conjunction, those who create and implement training protocols should be aware of and educated on SCT, and make adjustments when training an athlete with SCT.

Athletes with SCT do well when they are able to set their own pace, however because of the nature of sport that is not always possible. By understanding risk factors that may trigger exertional sickling episodes, as well as predisposing conditions athletic trainers can implement immediate treatment and prevent a critical situation.

Recognition

According to the NATA's Consensus Statement, *Sickle cell trait and the athlete,*[41] many of the cases of sudden death due to exertional sickling have common environmental settings. They identify early season conditioning where the athlete may be briefly sprinting 800-1600 meters, repetitive running of hills or stadium steps, intense sustained strength training, if the tempo increases late in intense one-hour drills, and at the end of practice when, historically, conditioning sessions occur. They also highlight on the fact that it doesn't only happen during conditioning activities, but also could happen during a game such as when a running back is in constant action during a long, frantic drive downfield. Because of the nature of sport, especially the conditioning aspect, it is important that athletic trainers are able to recognize and initially treat this pathology, in order to prevent more deaths.

The literature identifies many telltale features to aid in differentiating between a sickling episode and heat cramps.[39] First heat cramps normally carry a prodrome of muscle twinges and are excruciatingly painful, where as, exertional sickling does not have any prodromal symptoms and patients experiencing exertional sickling have a feeling of weakness in their muscles. Also the treatment and response is different, a patient experiencing mild exertional sickling feels fine after proper treatment, while heat cramps can take 1-2 hours to dissipate with proper treatment. Patients will often describe a feeling of extreme fatigue where they cannot even lift their arms or legs with exertional sickling. Patients with heat cramps feel their muscle "lock-up" and these muscles can be visibly contracted and feel hard, which is not found in exertional sickling.

Treatment

The collapse of an athlete with SCT should be treated as a medical emergency and immediate action should be taken. Vital signs must be checked and level of responsiveness assessed, if no vitals are present the EAP should be activated and basic life support should begin including cardio-pulmonary resuscitation and use of an AED. If vitals are present, with or with out cognitive impairment, high flow oxygen with a non-rebreather mask should be administered, it is recommended at a rate of 15lpm, if available. The athlete should be evaluated for a concurring heat illness and an accurate cure body temperature should be attained. If an EHI is present cooling should take place while still administering oxygen and routinely assessing vitals. If vital signs decline, or cognition does not improve then the EAP should be activated, as well as administration of intravenous fluid. EMTs and emergency department physicians should be notified that the patient is experiencing acute rhabdomyolysis and grave metabolic complications, in order to properly care for the individual.

Return to Play

Because of the metabolic complications that stem from acute rhabdomyolysis, caused by exertional sickling, return to play is individualized to each patient.[37] Some patients may be hospitalized for extended amounts of time due to renal failure or debilitating rhabdomyolysis. In a case of a college football player, the patient was hospitalized for 2 months was disqualified from sport participation due to the permanent loss of renal function.

If early symptoms are reported and quick treatment of rest, oxygen, and cooling is implemented athletes tend to rebound within 15-30 minutes. Eichner reports this quick turn around may be attributed to many or most sickle cells reverting quickly to normal shape as they transverse the lungs. In this case the athlete may be cleared for participation the next day.

The athlete that suffers moderate rhabdomyolysis will show a sharp rise in creatine kinase levels, however renal failure will not occur. Individuals that experience moderate rhabdomyolysis tend to have muscle weakness and soreness for up to a week, and daily assessment should be performed in order to ensure a gradual return to play.[37, 39]

ASTHMA

Epidemiology

Asthma is defined as a chronic inflammatory disorder of the airways that is characterized by variable airway obstruction and bronchial hyperresponsiveness.[42] Asthma has many causes and can be triggered by many stimulants. Some of which include pollen and other allergens, carbon dioxide, smoke, as well as exposure to cold and exercise. According to the Center for Disease Control 17.5 million adults (7.7% of the population) and 7.1 million children (9.9%) have asthma in the United States.[43]

Chronic bronchial inflammation can cause excess mucus build up and over time causes narrowing of the bronchials. This narrowing of the airways causes a decrease in maximal expiratory flow rate and causes air to be trapped. During asthma attacks the respiratory rate increases in order to compensate for the air that is trapped in the inflamed bronchioles. Because of this increased respiratory rate the muscles involved with respiration (the intercostals and diaphragm) must work harder, which causes muscle fatigue and combined with distress can cause death.

Exercise induced asthma (EIA) and exercise induced bronchospasm (EIB) are often used interchangeably, and for consistency, both pathologies will be referred to as EIA. EIA differs from traditional asthma because it is transient in nature and is an acute narrowing of the airways during and after exercise. The symptoms of EIA are consistent with and both pathologies are treated similarly.

Becker et. al identified 61 deaths attributed to asthma during or immediately following sport.[44] This study looked at deaths between July 1993 and December 2000 that occurred during or immediately after sport. The inclusion criteria were strict and included 1) symptoms had to have manifested during or immediately after sport participation 2) there had to be record or the athlete appearing well immediately before the event 3) autopsy had to conclude that asthma was the only cause of death. Due to these inclusion criteria the authors speculated that the number of deaths in sport due to asthma was higher. Another finding from this study was that the affected age range for these deaths was between the ages of 10 and 20 which a majority of the athletes in the United States fall in.

Prevention

The first step to preventing asthma deaths in sport is proper diagnosis. Pre-participation exams need to include sections that address asthma.[42] Common symptoms include, but aren't limited to, coughing, especially at night, chest tightness, wheezing, especially after exercise, and prolonged shortness of breath. When an athlete is suspected to have asthma the next step for proper diagnosis is pulmonary function testing.

In pulmonary testing many volumes of air are quantified throughout the breathing cycle. Three common measures of airway function are forced expiratory volume in 1 second (FEV_1), forced vital capacity (FVC) and peak expiratory flow rate (PEFR). FEV_1 is the amount of air forcefully expired in one second after full inspiration. FVC is the total amount of air forcefully expired after full inspiration. PEFR measures the maximal flow rate of air out of the airways. When traditional asthma is thought to be present these tests are conducted with the patient at rest, however it is suggested that when EIA is a possible diagnosis that the tests be administered during or immediately after a bout of exercise.

Recognition

Prompt recognition of a possible life threatening asthma attack is important in order to prevent unnecessary loss of life. Symptoms vary widely, but include inability to catch one's breath, shortness of breath, chest tightness, coughing or wheezing. When an asthma attack is suspected a step wise progression is recommended in order to differentiate between a transient asthma attack or an attack that is life threatening.

Initially the patient's peak flow should be established, using a portable peak flow meter. After a peak flow measurement is made the athlete should take their prescribed medicine, and after 15-20 minutes peak flow should be assessed again.

The EAP should be activated if the patient exhibits symptoms of respiratory distress such as significant increase in wheezing or chest tightness, respiratory rate greater than 25 per minute, inability to speak in full sentences, uncontrolled cough. In addition, signs of impending respiratory failure may be noticed and warrant immediate transportation to an emergency department. Signs of impending respiratory failure include weak expiratory efforts, weak breath sounds, unconsciousness, and hypoxic seizures.

Treatment

Initial treatment includes the use of inhaled β_2-agonists and corticosteroids. These medications are classified as short-term and long-term respectively. Long-term medications are also known as controller medications and are used prophylactically to manage asthma. These medications are taken regularly and have effects that last up to 12 hours. Due to the nature of these medications they should not be used during acute asthma attacks.

Short-term asthma medications act rapidly to combat the bronchoconstriction and symptoms associated with asthma. These medications are most commonly associated with athletes and are inhaled via a metered dose inhaler (MDI). The most commonly used medication is a rapid acting β_2-agonist. These medications quickly cause bronchodilation and promote airway relaxation. The rapid acting β_2-agonist has a duration of 4-6 hours, however with repeated use a tolerance may be experienced by the patient. It is recommended that all athletes that have asthma have a recue inhaler at all practices and games, as well as, the athletic trainer have a spare.

Proper administration of the rescue inhaler is also an important factor in treatment of asthma. The use of a spacer in conjunction with an MDI is recommended in order to be sure that the medication in properly inhaled into the airway. Also the availability of a nebulizer in also recommended in case of emergencies. A nebulizer administers the medication in the form of a mist, and should be used to administer treatment in the event that an athlete is unconscious, while waiting for EMS to arrive.

Return to Play

Each return to play scenario will differ from patient to patient. Asthmatic athletes are encouraged to follow up with their primary care physicians or specialists at least every 6 to 12 months.

Behavior modification has also been established as a way to return to activity without putting the athlete at risk. The American Academy of Allergy, Asthma, and Immunology (AAAAI) recommends that patients with asthma take part in team sports such as baseball, football and short distance track events.[45] These sports are chosen because of their requirement of short bursts of energy versus long sustained activity like that in soccer, basketball, field hockey, and long distance track events. Behavior modification may be difficult because of the nature of an athlete's sport. Because of this hurdle the NATA makes recommendations in their position statement.

The NATA recommends that athletic trainers and coaches consider having alternative practice sites, and modifying practice times based on pollen count. The reasoning behind this recommendation is to decrease the amount of allergens in the air and subsequently put the athlete at less risk for developing an acute asthma attack.

LEARNING METHODS

Learning methods employed in the healthcare setting are different than many other areas. The nature of these fields requires more than solely classroom instruction. Entry-level professionals, those immediately out of school, will be called on to utilize what they've learned in classroom settings and apply it to real life patients. Due to these demands, it is important that healthcare students get real life experience during their schooling. Dornan et al. conducted a review focused on early clinical and community involvement and how it affected healthcare students' learning. The authors concluded that early exposure to the clinical setting, early being defined as during the first two years of school, aided the students by helping them acquire a broader range of subject matter and makes their learning more real and relevant.[46] In another study Prince et al. showed difficultly by medical students in connecting theoretical knowledge into clinical practice.[47]

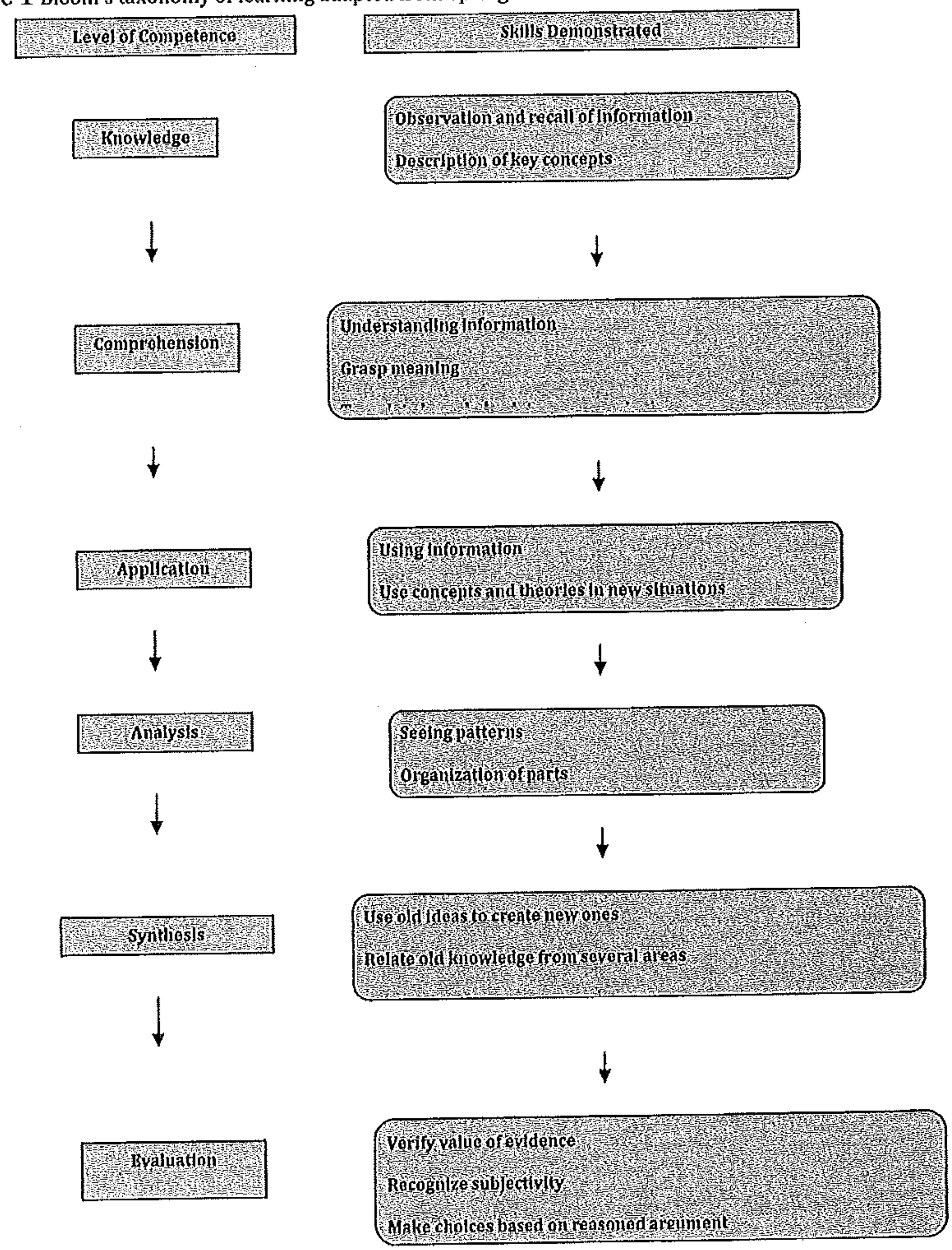
CAATE has established specific competencies in which each accredited program must prepare their students. These competencies are used as a "guide for the development of educational programs and learning experiences leading to a student's eligibility to challenge the Board of Certification, Inc. examination."[48] In essence, they are set forth to create continuity between different ATEPs. The content areas are grouped in three behavioral classifications, cognitive domain, which is knowledge and intellectual skills, psychomotor domain, manipulative and motor skills, and clinical proficiencies, which encompasses decision-making and skill application. These three classifications include the content areas set forth by CAATE. These content areas are foundational behaviors and professional practice, risk management and injury prevention, pathology of injuries and illnesses, orthopedic clinical examination and diagnosis, medical conditions and disabilities, acute care of injuries and illnesses, therapeutic modalities, conditioning and rehabilitative exercise, pharmacology, psychosocial intervention and referral, nutritional aspects of injuries and illnesses, healthcare administration, and professional developments and responsibility. [48]

These competencies were created with the intent to be utilized according to Bloom's Taxonomy of Learning (Figure 1). The hierarchy reported by Bloom identifies competency on six different levels and has skills associated with each level. These levels begin with basic knowledge in which students need only to recall, list, define and describe information, and evolve to the level of evaluation in which students can verify the value of evidence, as well as assess, decide, compare and grade information.

Problem Based Learning

One strategy being implemented in healthcare education today is the use of problem-based learning (PBL). PBL looks to bridge the gap between lecture based learning and clinical experiences by using contrived scenarios. The PBL approach is characterized by small group, self-directed learning led by a facilitator using a structured problem.[49] This approach is used most in traditional classroom settings, where it can be used to enhance student's comprehension of lecture. The main goal of PBL learning is the development of critical thinking and problem solving skills. These skills are of utmost importance in the healthcare field.

Figure 1 Bloom's taxonomy of learning adapted from Spring [50]



Peer Assisted Learning

The use of peers as teachers has been utilized in many healthcare fields such as medicine, physical therapy, occupational therapy, and nursing.[51] Various allied health education programs that have incorporated peer assisted learning (PAL) have reported positive outcomes. In athletic training education, PAL has been defined by Henning et al. as "the act or process of gaining knowledge, understanding, or skill in athletic training-related tasks among students who are at either different or equivalent academic or experiential levels through instruction or experience".[52] In essence, PAL is the use of students, who already know a certain skill set, as aides in instruction for other students.

Henning et al. conducted a study that looked at the use of PAL in athletic training education. This study found that in the clinical setting PAL was utilized by 66% of students surveyed, and that 60% of the participants reported feeling less anxious when performing clinical skills on patients in front of other students than clinical instructors.[52] Because of this positive feedback from students, this study recommends the deliberate incorporation of PAL in the classroom setting

In the Athletic Training Education setting

Mensch and Ennis conducted a study in 2002 that investigated the educational experiences in CAAHEP-accredited programs. CAAHEP is the Commission on Accreditation of Allied Health Educational Programs and has since been replaced by CAATE. The authors found specific themes across athletic training instructors, students, and programs. One of their themes was the use of scenarios and case studies as instructional tools.[53]

The use of scenarios is very similar to PBL, yet does not have the same structure in regards to the small group and self-directed learning. This study, in particular, describes the benefit of scenarios as being multi faceted. The authors state that the use of scenarios is an essential component for making education more meaningful, and increase the student's motivation to learn. It was also stated that scenario based learning helped students integrate their athletic training content knowledge. As well as enhancing student's integration of knowledge, scenario based learning has helped motivate students and make them more comfortable in the clinical setting. Included with scenario-based learning is the use of case studies as a means of advancing knowledge that students already have.

Case studies have been used in medicine for years as a way to present specific cases that could further clinicians' knowledge. The use of these case studies in the classroom is important because it trains future clinicians to use literature as a way of enhancing their knowledge and clinical practice. Case studies are important because there is a required knowledge application of real-life events and actual injuries can be integrated into the classroom.[53]

Athletic training also lends it hand to authentic learning experiences. These experiences do not always begin in the classroom, yet should be highlighted as a means of education. The hands-on learning experiences allow instructors the opportunity to demonstrate and critique student's ability to do things learned in lecture. Students in this study stated, "opportunities to apply knowledge and skills in classrooms and associated laboratories was an important aspect of their education".[53]

Participants of this study also noted that the experience of treating real athletic injuries was a more meaningful experience than structured experiences in classrooms and laboratories. Clinical rotations are a major aspect of athletic training education and diverse experiences are meaningful because of their "association to real-life athletic training". Even though there is an attempt to create these situations in the classrooms and laboratories, both instructors and students have suggested that this authenticity cannot be recreated. Clinical rotations' provide a means of extending the classroom knowledge and enhance student application of that knowledge.

REFERENCES

1. National Center for Catastrophic Sport Injury Research. Available at: http://www.unc.edu/depts/nccsi/. Accessed 2/22, 2011.

2. Casa DJ. *Preventing Sudden Death in Sport and Physical Activity*. Sadbury, MA: Jones, Bartlett Learning, LLC; 2012.

3. Maron BJ, Doerer JJ, Haas TS, Tierney DM, Mueller FO. Sudden deaths in young competitive athletes: analysis of 1866 deaths in the United States, 1980-2006. *Circulation*. 2009;119:1085-1092.

4. Jimenez CC, Corcoran MH, Crawley JT, et al. National athletic trainers' association position statement: management of the athlete with type 1 diabetes mellitus. *J Athl Train*. 2007;42:536-545.

5. Wetjen NM, Pichelmann MA, Atkinson JL. Second impact syndrome: concussion and second injury brain complications. *J Am Coll Surg*. 2010;211:553-557.

6. McCrory P, Meeuwisse W, Johnston K, et al. Consensus statement on concussion in sport - The 3rd international conference on concussion in sport held in Zurich, November 2008. *PM R*. 2009;1:406-420.

7. Guskiewicz KM, Bruce SL, Cantu RC, et al. National Athletic Trainers' Association Position Statement: Management of Sport-Related Concussion. *J Athl Train*. 2004;39:280-297.

8. National Spinal Cord Injury Statistical Center. Available at:

http://main.uab.edu/Sites/physicalmedicine/about/NSCISC/. Accessed 3/10, 2011.

9. National Spinal Cord Injury Statistical Center. Available at:

https://www.nscisc.uab.edu. Accessed 3/5, 2011.

10. Binkley HM, Beckett J, Casa DJ, Kleiner DM, Plummer PE. National Athletic Trainers' Association Position Statement: Exertional Heat Illnesses. *J Athl Train.* 2002;37:329-343.

11. Harris KM, Henry JT, Rohman E, Haas TS, Maron BJ. Sudden death during the triathlon. *JAMA.* 2010;303:1255-1257.

12. Walsh KM, Bennett B, Cooper MA, Holle RL, Kithil R, Lopez RE. National athletic trainers' association position statement: lightning safety for athletics and recreation. *J Athl Train.* 2000;35:471-477.

13. Harmon KG, Asif IM, Klossner D, Drezner JA. Incidence of sudden cardiac death in national collegiate athletic association athletes. *Circulation.* 2011;123:1594-1600.

14. Maron BJ. Sudden death in young athletes. *N Engl J Med.* 2003;349:1064-1075.

15. Kubo T, Gimeno JR, Bahl A, et al. Prevalence, clinical significance, and genetic basis of hypertrophic cardiomyopathy with restrictive phenotype. *J Am Coll Cardiol.* 2007;49:2419-2426.

16. Maron BJ. Hypertrophic cardiomyopathy: a systematic review. *JAMA.*

2002;287:1308-1320.

17. Maron BJ, Gohman TE, Kyle SB, Estes NA,3rd, Link MS. Clinical profile and spectrum of commotio cordis. *JAMA*. 2002;287:1142-1146.

18. Maron BJ, Poliac LC, Kaplan JA, Mueller FO. Blunt impact to the chest leading to sudden death from cardiac arrest during sports activities. *N Engl J Med*. 1995;333:337-342.

19. Maron BJ. The young competitive athlete with cardiovascular abnormalities: causes of sudden death, detection by preparticipation screening, and standards for disqualification. *Card Electrophysiol Rev*. 2002;6:100-103.

20. Andersen J, Courson RW, Kleiner DM, McLoda TA. National Athletic Trainers' Association Position Statement: Emergency Planning in Athletics. *J Athl Train*. 2002;37:99-104.

21. National Athletic Trainers' Association Official Statement- Automated External Defibrillators. Available at: http://www.nata.org/sites/default/files/AutomatedExternalDefibrillators.pdf. Accessed 3/5, 2011.

22. Pelliccia A, Zipes DP, Maron BJ. Bethesda Conference #36 and the European Society of Cardiology Consensus Recommendations revisited a comparison of U.S. and European criteria for eligibility and disqualification of competitive athletes with cardiovascular

abnormalities. *J Am Coll Cardiol.* 2008;52:1990-1996.

23. Korey Stringer Institute. Available at: http://ksi.uconn.edu/. Accessed 3/15, 2011.

24. American College of Sports Medicine, Armstrong LE, Casa DJ, et al. American College of Sports Medicine position stand. Exertional heat illness during training and competition. *Med Sci Sports Exerc.* 2007;39:556-572.

25. Roberts WO. Common threads in a random tapestry: another viewpoint on exertional heatstroke. *Phys Sportsmed.* 2005;33:42-49.

26. Casa DJ, McDermott BP, Lee EC, Yeargin SW, Armstrong LE, Maresh CM. Cold water immersion: the gold standard for exertional heatstroke treatment. *Exerc Sport Sci Rev.* 2007;35:141-149.

27. Casa DJ, Armstrong LE, Ganio MS, Yeargin SW. Exertional heat stroke in competitive athletes. *Curr Sports Med Rep.* 2005;4:309-317.

28. Rav-Acha M, Hadad E, Epstein Y, Heled Y, Moran DS. Fatal exertional heat stroke: a case series. *Am J Med Sci.* 2004;328:84-87.

29. NCAA Bylaws. Available at: http://www.ncaapublications.com/productdownloads/D110.pdf. Accessed 3/8, 2011.

30. Casa DJ, Csillan D, Inter-Association Task Force for Preseason Secondary School Athletics Participants, et al. Preseason heat-acclimatization guidelines for secondary

school athletics. *J Athl Train.* 2009;44:332-333.

31. Casa DJ, Armstrong LE, Hillman SK, et al. National athletic trainers' association position statement: fluid replacement for athletes. *J Athl Train.* 2000;35:212-224.

32. Armstrong LE, Johnson EC, Casa DJ, et al. The American football uniform: uncompensable heat stress and hyperthermic exhaustion. *J Athl Train.* 2010;45:117-127.

33. Craig JV, Lancaster GA, Williamson PR, Smyth RL. Temperature measured at the axilla compared with rectum in children and young people: systematic review. *BMJ.* 2000;320:1174-1178.

34. Smith JE. Cooling methods used in the treatment of exertional heat illness. *Br J Sports Med.* 2005;39:503-7; discussion 507.

35. Casa DJ, Becker SM, Ganio MS, et al. Validity of devices that assess body temperature during outdoor exercise in the heat. *J Athl Train.* 2007;42:333-342.

36. Hadad E, Rav-Acha M, Heled Y, Epstein Y, Moran DS. Heat stroke : a review of cooling methods. *Sports Med.* 2004;34:501-511.

37. Eichner ER. Sickle cell trait in sports. *Curr Sports Med Rep.* 2010;9:347-351.

38. Tsaras G, Owusu-Ansah A, Boateng FO, Amoateng-Adjepong Y. Complications associated with sickle cell trait: a brief narrative review. *Am J Med.* 2009;122:507-512.

39. Eichner ER. Sickle cell trait. *J Sport Rehabil.* 2007;16:197-203.

40. National Athletic Trainers' Association Consensus Statement: Sickle Cell Trait and the Athlete. Available at: http://www.nata.org/sites/default/files/SickleCellTraitAndTheAthlete.pdf. Accessed 3/10, 2011.

41. National Athletic Trainers' Association Consensus Statement: Sickle Cell Trait and the Athlete. Available at: http://www.nata.org/sites/default/files/SickleCellTraitAndTheAthlete.pdf. Accessed 3/6, 2011.

42. Miller MG, Weiler JM, Baker R, Collins J, D'Alonzo G. National Athletic Trainers' Association position statement: management of asthma in athletes. *J Athl Train.* 2005;40:224-245.

43. Center for Disease Control- Fast Stats- Asthma. Available at: http://www.cdc.gov/nchs/fastats/asthma.htm. Accessed 3/8, 2011.

44. Becker JM, Rogers J, Rossini G, Mirchandani H, D'Alonzo GE,Jr. Asthma deaths during sports: report of a 7-year experience. *J Allergy Clin Immunol.* 2004;113:264-267.

45. American Academy of Allergy, Asthma, and Immunology. Available at: http://www.aaaai.org/patients/gallery/asthma.asp. Accessed 3/5, 2011.

46. Dornan T, Littlewood S, Margolis SA, Scherpbier A, Spencer J, Ypinazar V. How can experience in clinical and community settings contribute to early medical education?

A BEME systematic review. *Med Teach.* 2006;28:3-18.

47. Prince KJ, Van De Wiel M, Scherpbier AJ, Can Der Vleuten CP, Boshuizen HP. A Qualitative Analysis of the Transition from Theory to Practice in Undergraduate Training in a PBL-Medical School. *Adv Health Sci Educ Theory Pract.* 2000;5:105-116.

48. Athletic Training Educational Competencies. Available at: https://cf.nata.org/education/competencies.htm.

49. Badeau KA. Problem-based learning: an educational method for nurses in clinical practice. *J Nurses Staff Dev.* 2010;26:244-9; quiz E1-2.

50. Spring H. Theories of learning: models of good practice for evidence-based information skills teaching. *Health Info Libr J.* 2010;27:327-331.

51. Secomb J. A systematic review of peer teaching and learning in clinical education. *J Clin Nurs.* 2008;17:703-716.

52. Henning JM, Weidner TG, Jones J. Peer-assisted learning in the athletic training clinical setting. *J Athl Train.* 2006;41:102-108.

53. Mensch JM, Ennis CD. Pedagogic Strategies Perceived to Enhance Student Learning in Athletic Training Education. *J Athl Train.* 2002;37:S199-S207.

INTRODUCTION

Athletic training education programs rely on the National Athletic Trainers' Association (NATA) Education Competencies[1] to guide curriculum development and implementation as they provide the guidelines for entry-level knowledge and clinical skills to be mastered prior to certification and provision of services to patients. The document, although specific in content and knowledge, allows for autonomy among programs to deliver this information through instructional methods to their own selection. Programs often utilize a combination of didactic learning and clinical education experiences to help facilitate the knowledge and skill acquisition as outlined in the NATA Education Competencies. Moreover, athletic training educators rely on previous educational training and personal experiences to guide knowledge shared to their students and instructional style selection to deliver the information necessary.[2,3]

Commonly, athletic training educators utilize traditional teaching methods, such as lecture or instructor driven discussion sessions, to relay the cognitive knowledge outlined in the NATA Education Competences and laboratory sessions under the directed supervision of an instructor to provide clinical skill integration.[2] Athletic training students, despite lacking a specified learning style, welcome classroom and clinical experiences, which boast authenticity to allow for critical thinking and competency development.[4] In addition to spending time engaged in clinical education experiences, athletic training students are often exposed to problem-based learning techniques, simulations, and case study discussion in the classroom as a means to promote genuineness to the learning experience.[2,3] One particular content area that requires realism in learning experiences is the area of preventing sudden death and emergency procedures. Although a rare situation, sudden death in sport has become a very relevant topic for athletic training professionals due to its preventability and recent media coverage.

Sudden cardiac death, head injuries, and heat illnesses are among the top 3 causes of sudden death in sport.[5,6] Since 1982, 1866 sudden deaths have been recorded during sport participation[6,76] with the 3 previously mentioned causes receiving the most attention in the media, as well as by researchers. The attention has focused on the best methods to prevent the occurrence, evaluate the conditions for diagnosis, and appropriate measures for treatment and care. The NATA Educational Competencies have reflected this information within the cognitive and psychomotor skills, as well as clinical integration proficiencies, which require the athletic training professional to be versed in emergency care procedures.[1] Furthermore, the textbook *Preventing Sudden Death in Sport and Physical Activity*[5] was released in summer of 2011, the first to examine the causes of sudden death and their signs, symptoms, and treatment protocols. The overall objective of the book was to educate the sports medicine professional regarding the most appropriate measures when faced with an emergency situation[5]. Previous research has indicated athletic trainers rely heavily on previous educational training and professional experiences[2] when selecting diagnostic tools and management protocols; therefore providing them with the most current knowledge and skills is imperative to prevent death in sport.

Exertional heat stroke (EHS) has received a majority of the attention surrounding sudden death in sport in the past few years mostly due to its growing occurrence. This growing rate is alarming because EHS is preventable and treatable once diagnosed. Lack of confidence or comfort[8] with the skills associated with the recognition and treatment of EHS due to a lack of specific training[2, 3] was found to be the chief reason for the athletic trainer to avoid using rectal temperature assessment and cold-water immersion. Since educational training can be critical in providing the future athletic training professional with the competence and confidence necessary to utilize the skills to manage an emergency situation, it is important to ascertain how these students are being trained. Information specific to EHS has been gathered previously, however, the broader topic of sudden death has yet to be investigated. Therefore, the purpose of this study was to build upon the work of Mazerolle and colleagues to learn how athletic training education programs (ATEPs) prepare students to be competent in emergency care procedures. Specifically, we were concerned with the students' knowledge regarding the causes of sudden death, instructional methods used to impart the knowledge and skills, and confidence with management of a potential emergency situation arises.

METHODS

In this exploratory study, we used a mixed-methods approach to discover whether the entry-level athletic training professional is prepared to handle and manage a case of sudden death. The study design relied heavily on qualitative methods, as it provides the best insight into human behavior, attitudes and beliefs.[9] Moreover, it allows the researcher to develop a theory from the collected data to identify and explain possible reasons for human behavior or actions.[9, 10] The use of a short, but in-depth, survey instrument also helped quantify the experiences of these participants, and helped to support the data generated by the individual interviews. The University of Connecticut Institutional Review Board approved all aspects of the data collection process including the initial recruitment letter (Appendix A), consent form (Appendix B), background questionnaire survey (Appendix C) and interview guide (Appendix D).

Participants

A total of 13 participants (n=7 males, 6 females age: 23 $\pm$ 2 years) took part in this study. The participants were a mixture of students enrolled in their final semester of undergraduate education, and recent graduates currently practicing as a clinical athletic trainer, either through a graduate assistantship, internship, or full time employment. We initially sent emails explaining the study and steps for data collection to 150 randomly selected program directors (PD) in CAATE accredited programs to help facilitate enrollment into the study. This helped recruit the participants, as currently there is not a database for student members enrolled in CAATE programs.[10, 11] The PD was asked to first review the email, which also contained the consent form and background questionnaire survey, then forward it to all current students and recent graduates. Any interested participant directly contacted the investigators. Also, the researchers capitalized on pre-existing professional relationships, to help identify potential participants meeting the criteria.[12] After the initial emails, recruitment continued by snowball sampling,[10, 12] as recruited participants were utilized to recruit additional participants.

Data Collection

A background questionnaire was filled out by all participants in order to gain demographic information and each participant's base of knowledge regarding preventing sudden death. Semi-structured phone interviews were conducted with all participants after completion of the background survey. Based upon the purpose and research agenda, the researchers developed a series of questions using a semi-structured, open-ended format. This format was selected due to the flexibility afforded to further explore the topic, particularly because of the sensitivity behind the topic as well as the autonomy afforded to each athletic training program.[10] Both the background survey and interview guide was developed by a research team, which was comprised of five members. Those members included two athletic training educators, two graduate assistant athletic trainers, and one qualitative researcher. Prior to data collection, the background questionnaire and interview guide were reviewed by two experts not involved with the data collection procedures, whose background is in preventing sudden death. After all documents were completed and returned via email or fax, a phone interview time was established. A small pilot study was conducted after the initial review by the experts with a small cohort of students (n=2). Updates and changes were made to the interview items for clarity's sake.

Interviews were at the convenience of the participant, conducted during the spring semester (within two weeks of graduation for the ATS), and lasted between 20 and 30 minutes. All interviews were audio recorded, transcribed verbatim, and destroyed once transcription was complete. All transcriptions were electronic and stored on the principal investigator's and student researchers' computers. Only the researchers (included in Appendix I) involved in the study had access to the transcripts, which were destroyed upon completion of data analysis. All names used were pseudonyms.

Data Analysis and Trustworthiness

Interview transcripts were analyzed using a modified ground theory approach as summarized by Strauss and Corbin[13, 14] as well as other researchers.[12, 15] The transcriptions were read completely to gain a holistic understanding of the data. On subsequent readings, specific incidents and commonalities were given labels to represent their meaning within the transcripts. The research agenda and questions were used to guide data analysis. Once initial coding procedures were completed, the researchers discussed the concepts and commonalities and were found to be in agreement of the over-arching themes of the interviews.

Credibility of the research procedures and trustworthiness of the data analysis and interpretation were established using three strategies[10]: 1) methodological triangulation 2) transcript verification, and 3) multiple analyst triangulation. Using both in-depth phone interviews and a survey questionnaire helps triangulate the results from the interviews by verifying and supporting the data generated from the survey questionnaire.[9, 10] Participant verification was secured by allowing the interview participants the ability to review their transcripts from the recorded interviews. Participants were allowed to make any changes or updates to ensure accuracy.

RESULTS

One dominant theme emerged from the data to explain how ATEPs prepare their students to be competent regarding emergency care procedures: *compartmentalized.* The theme of *compartmentalization* reveals the participants' reflections that while they received the cognitive knowledge regarding sudden death in sport, they had minimal hands-on practice of certain skills associated with those conditions. The athletic training students (ATS) revealed that educators utilized traditional teaching methods, such as lecture and discourse, to relay cognitive knowledge regarding sudden death in sport. Also, laboratory time to provided practice time for basic skills, such as spineboarding and first aid, but that time was limited. The ATS revealed a focus on situations or cases athletic training educators had encountered versus the broader scope of conditions that may cause sudden death. When evaluating the ATS's ability to critically apply their knowledge and psychomotor skills, little real-life integration was used but rather more contrived discussion-based instructional methods. This limited, in their opinions, development of critical thinking and confidence with emergency care procedures. Figure 1 provides an illustration of the findings and a complete discussion ensues with supporting quotes from the participants.

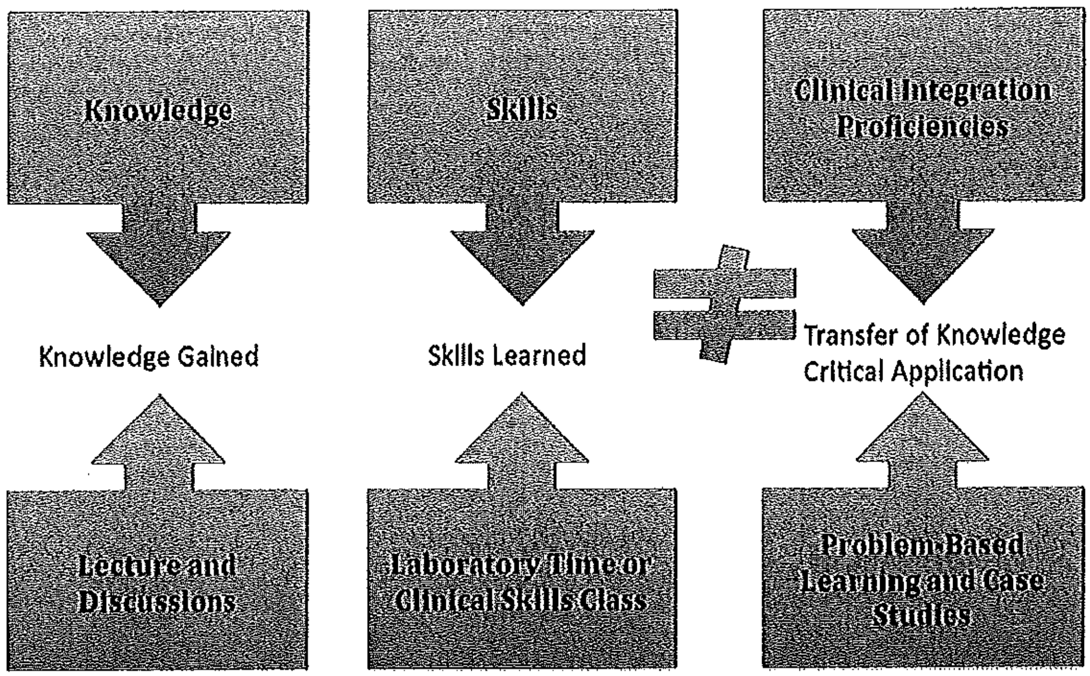


Figure 1. Compartmentalization of Educational Practices

Compartmentalization

Compartmentalization can be summarized by three key categories: *cognitive knowledge*, *skill implementation*, and *clinical integration* as depicted in Figure 1. Participants acknowledged gaining the appropriate knowledge related to sudden death, but realized that only certain concepts received hands-on training or chances to critically apply their knowledge gained in the classroom setting.

Cognitive Knowledge

According to the participants, information regarding sudden death or emergency care procedures was distributed throughout their undergraduate academic experiences versus in one class solely devoted to emergency procedures. Several participants indicated that time spent on sudden death was very limited, with a majority of the coursework devoted to evaluation of orthopedic injuries and management of those pathologies. James illustrates this finding when he shared, "I'd say from sophomore year throughout [the program], [sudden death] is not a major time commitment, just because there is so much other material we have to know." Another participant, after assuming a full-time position, realized they felt inadequately prepared regarding sudden death. Denise disclosed,

> These disorders were taught straight from the book instead of saying these are the things that might happen that can differentiate what you're going to do. When I came [to my first job] I felt like there were athletic trainers who were more prepared than me, who knew more about sudden death prevention and management.

Classic didactic practices were the most commonly utilized method of instruction in terms of managing a condition that may lead to sudden death. Allen said, "I'd say mostly lecture was the primary means of education." Hannah had a similar reflection regarding use of instructional methods saying,

> It was more lecture based and [class] discussion. We'd have a PowerPoint, a scenario presented, and interactive discussion led by the teacher. I don't remember anything other than practicing spine boarding and CPR.

Laurie, too, reflected, "For CPR and first aid there was a lab component, but as far as heat illness and other pathologies that was only taught through lecture." Delivery of information related to sudden death in sport, as supported by the previous quotes as well as the following, was mainly achieved through traditional lecture, and in some cases class led discussions but rarely reinforced with skill development. Mandy said, "[We learned] about the different conditions, not necessarily hands on practice of evaluating and managing these conditions."

Information was also gathered regarding the ATS knowledge of the NATA position statements that were specifically related to sudden death in sport. Many, but not all, of the ATS were aware of the position statements. However, full comprehension of the information contained in each position was limited. Several indicated that the position statements were not used as a part of their educational preparation. Table 2 shows the 12 NATA issued statements associated with preventing sudden death and how many used each in their education. Three ATS reported never learning about Sickle Cell Trait, therefore, they were not familiar with the condition or that there was an NATA issued

Table 2. NATA Position Statements Use in Class and Students' Comfort Level

Statement	Have Read the Position Statement		Comfort Level with Position Statement*	
	Yes	No	High	Low
Emergency Planning	12	1	12	1
Asthma	9	4	8	5
AEDs	9	4	8	5
Commotio Cordis	6	7	5	8
SCA in HS & Colleges	5	8	5	8
Diabetes	9	4	7	6
Heat Illnesses	12	1	11	2
Youth FB & EHI	8	5	8	5
SCT	8	5	7	6
Concussion	12	1	10	3
Lightning	10	3	10	3

*Comfort level was assessed on a Likert scale of 1-10; a score was considered low if it fell between 1-5, and high scores fell between 6-10

statement.

Laboratory Time

Throughout our interviews, participants consistently acknowledged that they had received minimal hands-on practice of a majority of the psychomotor skills associated with preventing sudden death, such as measuring blood sodium or glucose levels, administration of an epinephrine auto injector, or rectal temperature assessment. Practice or laboratory time was primarily focused on the more traditional skill sets related to emergency care, such as first aid, CPR, and spineboarding. Table 3 presents the average time, in hours, spent on each of the leading causes of sudden death as estimated by the participants. The participants were asked for each condition, "How many hours of classroom time were spent on the education of [that specific condition]?" The participants gave a wide range of answers as indicated by the large standard deviations. Head injuries, cardiac conditions, and exertional heat stroked were reported to be the conditions that were given the most emphasis in our participants' ATEP. Joe said while discussing his educational experiences with sudden death, "I don't remember anything other than practicing spine boarding and CPR." Joe, when asked specifically about other skill sets, such as cold-water immersion or oxygen, said "No we did not practice those skills." James echoed Joe's evaluation of time spent in a clinical skills lab, "We'd go over something [in class], then have a lab session for the topic. We did not do a lot of lab work with the emergency protocols or conditions. The majority of the lab stuff [related to sudden death] did deal with spine boarding."

Table 3. Hours Spent per Condition*		
Condition	Hours (mean)	Standard Deviation
Analphalaxis	3	2
Asthma	4	3
Cardiac	8	6
Diabetes	4	3
Exertional Heat Stroke	8	5
Exertional Sickling	3	3
Head Injuries	11	10
Hyponatremia	4	4
Hypothermia	3	3
Lightning	3	2
Spinal Cord	7	4
Other Trauma	6	4
*Hours is an hour of actual class time		

Several participants noted being lectured on a particular topic or concept related to sudden death, but not having the opportunity to practice the skills being discussed. Andrea alluded to a lack of skill development sharing this reflection; "I think if our emergency class went more in depth into conditions that cause death and if we had time to practice the different procedures associated with these conditions I'd be a little more comfortable." Another participant recognized that more time was spent on the day-to-day type of injuries an athletic trainer was likely to see rather than conditions related to sudden death. He shared, "It really wasn't stressed as much in our education. We focused more on getting evaluation experience and the day-in, day-out operation of athletic training. There [were] some times where we would go over it, but it wasn't as much as I think it should be."

This group recognized the importance of practicing clinical skills before they actually employ them in clinical setting. All participants, when asked about ways to improve competence and confidence with management of a potential case of sudden death, discussed more hands on training beyond spineboarding or CPR. Denise said, "Absolutely [need more time practicing]". Another shared, "The kind of hands-on experience [we had in the classroom] such as more time practicing cold-water immersion or oxygen administration, actual AED administration could be improved on as well." Similarly, another stated,

> I think more hands-on practice in the classroom that give you opportunities to practice different skills. And also more time focused on each specific condition and how to manage those situations in class in general, instead of just touching on different topics in many classes.

Opportunities for development of skills related to the diagnosis and treatment of certain conditions related to sudden death in sport were not afforded to the ATS as highlighted by the participants' reflections. Consistently, CPR and spineboarding skills were discussed, but rarely were other skills, such as oxygen administration, or cold-water immersion.

Clinical Integration

The participants described their learning opportunities related to sudden death as structured around traditional methods such as lecture, laboratory time, and facilitated discussions. Missing, however, was the chance to integrate their knowledge and skills in a real-time clinical setting with patient care. A majority of the participants discussed the use of case studies or simulations as the only means to apply their knowledge pertaining to sudden death, but recognized they were contrived and lacking realism. Lexi said,

> We did some case scenario work [in our class]. We would "talk" through the process of managing a condition in a small group or individually. I think those small group discussion/case scenarios are kind of a big component of the education and integration of materials.

Allen, also described limited time to integrate his knowledge,

> Everything was presented as cut and dry [in our classes]. They [my instructors] used scenarios in the class. The class was used as a lab to practice what we were learning [in the didactic class] because little happened in the clinical sites [related to sudden death]. Outside of the clinical class there isn't much exposure. In football we practiced spine boarding and reviewed the EAP, but outside of that there was not much integration.

One participant did discuss the importance of real-time learning or comprehensive patient care in learning. He shared this experience regarding a cardiac event,

> During camp we had a student who lost consciousness in the ATR and the EAP was initiated. One of our [certified] athletic trainers performed CPR, and I was charged with waving in the ambulance. It was surreal [experience]. Also, one of the other [assistant] ATs activated the EAP. They instructed everyone where to go and a second [certified] athletic trainer helped keep everyone clear and aided in instructing people where to go.

Overall this cohort, when asked to evaluate their program's success [on a Likert scale] in preparing them to manage a potential case of sudden death responded with a score of 6 ± 2. Most likely the limited time spent on several of the conditions related to sudden death in sport influenced this rating as well as the lack of clinical integration. Ken rated his abilities, "6.5-7." He followed this up by sharing, "because just having a summer course is not enough [to feel prepared]." Comparably, Mandy replied, "8: I feel fairly confident I'd do everything right, but I don't have a ton of experience [from the classroom or clinic] to aid me in this situation."

DISCUSSION

In this exploratory study we sought to understand how athletic trainers were prepared to manage emergency conditions. Specifically, we were concerned with the ATS's knowledge regarding the causes of sudden death, instructional methods used to impart the knowledge and skills, and confidence with management if a potential emergency situation arises. Our results indicate that AT professionals, during their undergraduate training, are given limited opportunities to develop clinical competence to recognize, treat, and manage these emergency situations. Like the work of Mazerolle *et al*.,[2, 3, 8] our findings illustrate that the pre-professional receives limited opportunities to gain hands-on training and clinical integration of those skills necessary to manage certain causes of sudden death in sport during their educational training. Additionally, the results of this study correspond with the work of Mazerolle *et al*.,[2, 8] which found that many AT educators and clinicians are not utilizing evidence-based best practices in clinical practice or when instructing about recognition and management of EHS, just one of the causes of sudden death. In the present study, we found that many participants described a compartmentalized educational experience; whereas, there was little opportunity for the integration of their cognitive knowledge and psycho-motor skills learned via traditional instructional methods, such as lecture, discussion, or laboratory sessions. The value of applying knowledge to authentic, real-life experiences is well documented in the literature[4, 16, 17] for those students enrolled in medical and healthcare programs. Therefore, our data indicates that AT educators need to incorporate more opportunities for implementation of learned knowledge that include modeling and feedback.[4]

Cognitive Knowledge

Comparable to the literature regarding instructional methods utilized to educate the ATS on EHS practices,[2, 8] our findings indicated the prevalence of a traditional lecture-based style to deliver the foundational concepts related to sudden death in sport. The use of lecture is most important when delivering the foundational concepts related to a topic, particularly when discussing the signs and symptoms of a condition or ways to evaluate or manage the condition. AT educators, when initially introducing the conditions related to sudden death in sport, are encouraged to utilize this method of instruction as it allows for the development of a strong underpinning. Lecture, however, offers little opportunity for the development of analytical thinking for the learner, and therefore other methods are necessary to foster the development of clinical competence[18]. Mazerolle *et al.*[19] found that the ATS who is not afforded the opportunity to gain hands-on training with rectal temperature assessment and cold-water immersion for the recognition and treatment of EHS feel less comfortable with the use of the devices; a crucial factor that impedes implementation of those methods into actual clinical practice by the AT.[8]

Several more traditional instructional methods are available to the AT educator, that still capture the more traditional components of a lecture-based style but facilitate learning in a more real-time environment. Dialogical discourse, experiential learning, and background connection activities can afford the AT educator with the chance to provide realism to information being delivered in the classroom setting.[2, 18] AT educators appear to capitalize on the use of case studies and case-contrived problem-based scenarios to replicate authentic learning experiences; something previously indicated as important for learning and development of confidence clinically.[4] The use of contrived scenarios with instructor or peer driven discourse is helpful for learning and is also used by AT educators when covering EHS.[2] Although an important means to promote realism and critical application of knowledge, the scenarios discussed by our participants did not require implementation of skills related to the recognition and care of many of the causes of sudden death in sport.

Similar to Mazerolle *et al.*[2, 8, 19] information being delivered by the traditional means of instruction was derived from the NATA position statements. Our findings also support the findings of another study examining the educator's views on preparing the ATS to manage an emergency situation, which suggests more instruction time is spent on such topics as general emergency planning, heat illnesses, cardiac issues, and concussions.[3] Interestingly, however, our participants were more versed regarding the NATA position statements on emergency planning and concussions, but less comfortable with those related to sudden cardiac arrest; the leading cause of death in sport and often a topic considered of importance for AT educators.[3]

Laboratory Time

A predominate theme echoed by many of our participants was the lack of laboratory time to practice hands-on skills associated with preventing sudden death.[8, 19, 20] The majority of laboratory time as discussed by this group of AT professionals was spent on first aid, CPR and AED, and spineboarding, and little or no time was allotted for skills such as rectal temperature assessment, epi-pen training, or glucose testing. This can be partially explained by an AT educator's previous clinical experience, which has been found to mediate selection of topics covered and time allotted for learning.[3] The finding can also be justified by an AT educator's previous educational training and comfort level with providing instruction and feedback to the ATS.[2]

The NATA's Fifth Edition of the Athletic Training Education Competencies[1], makes significant changes regarding concepts related to sudden death in sport. Specifically, those changes include: "the addition of skill in assessing rectal temperature, oxygen saturation, blood glucose levels, and use of a nebulizer and oropharyngeal and nasopharyngeal airways.[1]" The update to the competencies reflects the recommendations of NATA position statements and the most current evidence regarding these concepts. AT educators must be prepared to not only provide the ATS with this information via lecture, but also the chance to learn to develop competence in using those skills through directed instruction during laboratory sessions. The AT professional must be aware of all NATA position statements as well as be prepared to utilize the recommendations made within those statements in order to provide optimal care to their patients as well as to fulfill their obligations to their certification and licensure as an athletic trainer. The seriousness of sudden death in sport requires the AT educator to facilitate learning opportunities which provide the ATS with the chance to apply their knowledge and skills in an authentic experience to develop clinical competence.

Clinical Integration

The lack of integration in the clinical setting emerged partly due to the previous theme, laboratory time, but also due to the reliance on lecture based techniques to deliver the information regarding sudden death in sport. Our participants indicated that their AT educators try to bring realism to the topics through various methods including case studies, personal stories, and class discussion. However, they also noted that they were rarely forced, during these classroom experiences, to implement or apply their knowledge. Again, the ATS seeks authentic learning experiences to gain understanding and competence but in the case of sudden death, due to its rarity of occurrence, the chance to practice those skills in controlled environment is imperative to gain competence.

The use of clinical practicum experiences is often an instructional method used by ATEPs to facilitate real-time learning. However as mentioned cases of sudden death do not occur regularly as do other musculoskeletal injuries; therefore the chance to apply their skills is limited. Moreover, because of the seriousness of emergency conditions, when a situation such as an EHS or spinal injury occurs a supervising clinical instructor is more likely to use the student as a means to alert emergency medical services, limiting their opportunity to actual apply their knowledge and skills in the management of the situation. Recognizing this, AT educators need to provide more experiences that foster realism to allow for competence to develop. In addition to incorporating more realistic classroom experiences, AT educators should consciously implement critical thinking methods in order to replicate real life situations.

The importance of replicating real life situations in the classroom is paramount because a study conducted by Mench and Ennis revealed that many ATS and AT educators reported treating real patients in clinical rotations was more meaningful than laboratory or classroom experiences.[4] Solely teaching the material and performing laboratory sessions is simply not enough because there is nothing that brings both the cognitive knowledge and psychomotor skills together in a practical manner. Many of our participants recalled minimal integration of clinical scenarios in the classroom. Therefore, bringing more real life scenarios into the classroom can begin to bridge the gap between lessons in the class and practice in the field.

Recommendations

Our study illustrated that many entry-level ATs are not being provided with the opportunity to develop clinical competence to deal with emergency situations and prevent sudden death in sport. In order to better prepare ATs, the AT educator should incorporate more realistic case scenarios into the classroom, provide more hands-on training with all skills related to sudden death in sport, not just those they feel comfortable in teaching, and finally must create opportunities for critical application of both knowledge and skills associated with preventing sudden death.

In regards to emergency procedures, traditional instructional methods should not be completely dismissed; however, they should not be the sole method of education. Hands-on training for all skills must be afforded each ATS. During the laboratory sessions the following must be provided to the ATS: 1) the instructor must model the skills before the ATS practices, 2) feedback for learning and improvement must be given, and 3) an authentic environment for implementation must be created to provide authenticity.[17] Furthermore, effort should be made to create an environment in which ATS are forced to critically think and apply what they have learned including both their knowledge and skills. Most often the ATS is only asked to recall the information during class discussions or case study presentations, rather than implement the necessary skills they've recalled as important to implement. Case studies, scenarios, and problem-based learning can still serve as the foundation, but the AT educator must require the ATS to go beyond memory recall and apply their knowledge and skills to demonstrate higher level thinking.

Limitations

We recognize that our study has some limitations. The first was a small sample size, which was a split sample of first year AT professionals and ATS in their final year of academic study. Although our results support previous literature[2, 8, 19] the findings can really only be generalized to those AT professionals who have recently completed their degree programs. The rationale behind including both recent graduate ATs and those who were one year removed from study was to capitalize on participant's reflections regarding their experiences. Inclusion of both criteria also allowed us to triangulate the data gaining both an immediate evaluation of the program's performance versus a year to reflect upon those experiences.

Future Research

Future research should evaluate the effectiveness of the use of more realistic instructional methods and hands-on practice. Areas of interest may look at specific educational techniques including contrived laboratory situations, problem based learning, and practice in the clinical setting. In conjunction with looking at ATS's education in the clinical setting, more research can be performed looking at how approved clinical instructors teach in the clinical setting while still providing care to athletes.

Another area to investigate more deeply is a prospective study using ATS and follow them for an amount of time through their career to see how their perspectives change about their educational programs have changed, and how their education as an ATS has affected them as a professional in the field.

CONCLUSION

Our study found that many ATSs are given a good basis of knowledge throughout their pre-professional education. However, this education is focused mainly on evaluation and treatment of orthopedic injuries. We found that minimal time was devoted to the evaluation and immediate care of emergency situations, and even less time devoted to the practice of skills associated with the management of such conditions. We feel as though more time must be placed on the practice of these skills and the integration of this knowledge to the clinical setting. In educating athletic trainers, it is not enough to solely give information and have the ATs regurgitate facts, we must strive to create an educational environment that breeds great healthcare professionals that are prepared to deal with any type of condition no matter how menial or grave.

REFERENCES

1. National Athletic Trainers' Association: Athletic Training Education Competencies 5th Edition Available at: http://www.nata.org/sites/default/files/5th-Edition-Competencies-2011-PDF-Version.pdf. Accessed 1/4, 2011.

2. Mazerolle SM, Ruiz RC, Casa DJ. Evidence-based practice and the recognition and treatment of exertional heat stroke, part I: a perspective from the athletic training educator. *J Athl Train.* 2011;45(5):523-532.

3. Mazerolle SM, Salvatore AC, Casa DJ. *Educators Selection of Pedagogical Strategies to Prepare the Entry-level Athletic Trainer on Techniques Related to Sudden Death in Sport.* [Matser's Thesis]. Storrs, CT: University of Connecticut; 2012.

4. Mensch JM, Ennis CD. Pedagogic Strategies Perceived to Enhance Student Learning in Athletic Training Education. *J Athl Train.* 2002;37:S199-S207.

5. Casa DJ. *Preventing Sudden Death in Sport and Physical Activity*. Sadbury, MA: Jones, Bartlett Learning, LLC; 2012.

6. Mueller F, Cantu R. National Center for Catastrophic Sport Injury Research. Available at: http://www.unc.edu/depts/nccsi/. Accessed 3/7, 2011.

7. Maron BJ, Doerer JJ, Haas TS, Tierney DM, Mueller FO. Sudden deaths in young competitive athletes: analysis of 1866 deaths in the United States, 1980-2006. *Circulation.* 2009;119:1085-1092.

8. Mazerolle S, Pinkus D, Casa D. Evidence-based medicine and the recognition and treatment of exertional heat stroke, part II: a perspective from the clinical athletic trainer. *J Athl Train.* 2011;45(5):533-542.

9. Merriam S. *Case Study Research in Education: A Qualitative Approach.* San Francisco, CA: Jossey-Bass; 1988.

10. Pitney WA, Parker J. *Qualitative Research in Physical Activity and the Health Professions.* Champaign, IL: Human Kinetics; 2009.

11. Creswell JW. *Qualitative Inquiry and Research Design: Choosing among Five Traditions.* Thousand Oaks, CA: Sage Publications; 1998.

12. Crewswell JW, Plano Clark VL. *Designing and Conducting Mixed Methods Research.* Thousand Oaks, CA: Sage Publications; 2007.

13. Strauss AL, Corbin JM. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques.* Newbury Park, CA: Sage Publications; 1990.

14. Glaser BG, Strauss AL. *Discovery of Grounded Theory: Strategies for Qualitative Research.* Chicago, IL: Aldine; 1967.

15. Patton MQ. *Qualitative Evaluation and Research Methods.* 2nd ed. Newbury Park, CA: Sage Publications; 1990.

16. Rich VJ. Clinical instructors' and athletic training students' perceptions of teachable

moments in an athletic training clinical education setting. *J Athl Train*. 2009;44:294-303.

17. Victoroff KZ, Hogan S. Students' perceptions of effective learning experiences in dental school: a qualitative study using a critical incident technique. *J Dent Educ.* 2006;70:124-132.

18. Casa TM, Casa DJ. Dialogical Discourse: higher-level learning through class discussions. *Athl Ther Today*. 2007;12(2):25--29.

19. Mazerolle SM, Pagnotta KD, Casa DJ. Professional preparation regarding the recognition and treatment of exertional heat stroke: the student perspective. *Athl Train Educ J*. 2012;6:5-16.

20. Mazerolle SM, Scruggs IC, Casa DJ, et al. Current knowledge, attitudes, and practices of certified athletic trainers regarding recognition and treatment of exertional heat stroke. *J Athl Train*. 2010;45:170-180.

APPENDIX A

Dear [Program Director],

Hello, our names are Anthony Salvatore and Tom Yabor and we are currently masters' students at the University of Connecticut. We are writing to petition your help recruiting participants for our research study. In this study, which is part of our thesis projects, we are investigating the academic preparation of entry-level athletic trainers in dealing with sudden death in sport. We are currently looking for two groups: 1) senior level athletic training students who plan to work as an athletic trainer next year, and 2) faculty who currently teach course materials related to sudden death in sport.

As you may know sudden death in sport is an epidemic that is becoming more publicly acknowledged. As athletic trainers it is our responsibility to know how to act in these situations in order to save life. Our study will delve into the academic preparation of athletic training students in order to examine their confidence in dealing with cases of emergency care, as comfort and previous experience seem to mediate appropriate care.

Our data collection method will be two fold. First a background questionnaire will be filled out online by each participant. Second a phone interview will be conducted once consent is gained and a completed questionnaire is received. Phone interviews will be scheduled when convenient for both the investigator and participant. Interviews will last approximately 30-40 minutes. All participants will be assigned a pseudonym and throughout the process will be referred to by these pseudonyms to ensure confidentiality.

Your participation in this study would be much appreciated. Thank you for your consideration. If you are interested, or know someone who might be eligible please forward this information along. If comfortable send investigator contact information and investigators will contact directly.

Sincerely,

Anthony Salvatore ATC and Thomas Yabor ATC
Student Investigators

Stephanie M Mazerolle PhD, ATC
Faculty Supervisor

APPENDIX B

Consent Form for Participation in a Research Study

University of Connecticut

Principal Investigator: Stephanie Mazerolle, PhD, ATC

Student Researcher: Anthony Salvatore, ATC, Thomas Yabor, ATC

Study Title: Emergency Preparedness of Entry-level Athletic Trainers Regarding Preventing Sudden Death and Emergency Procedures

<u>Introduction</u>

You are invited to participate in a research study to explore the educational preparation as it relates to preventing sudden death in sport within athletic training education programs. You are being recruited because you meet our pre-determined criteria as either 1) instructor of material related to sudden death in sport in an athletic training curriculum, 2) or you are a senior athletic training student who plans to attend graduate school or accept a full-time position as an athletic trainer.

This consent form will provide you with the information needed to understand the purpose of this study and its significance. It will also highlight your role as a participant and steps for completion of the study. We also encourage you to ask questions now and at any time. If you decide to participate, you will be asked to sign this form and it will be a record of your agreement to participate. You will be given a copy of this form. You can return the form via standard mail, or if comfortable via fax (860-486-1123). The fax machine is located in the main office of the department, and only the administrative assistant has access to the fax machine. Returned faxes will be immediately given to the investigators.

<u>Why is this study being done?</u>

The objective of the study is threefold: 1) to determine how are entry-level athletic trainers being prepared to handle sudden death in sport, 2) to determine knowledge of the entry-level athletic trainer and athletic training educator regarding sudden death in sport, and 3) to determine whether knowledge and understanding of the conditions match the athletic trainer's comfort level in handling a potential case.

What are the study procedures? What will I be asked to do?

There are two phases to the research study. In phase I you will be asked to complete a background questionnaire. The background questionnaire will ask you general questions about your experiences and knowledge regarding sudden death in sport. We anticipate this portion of the study to take about 20 minutes and this portion will take place online via survey monkey. Phase II of the study involves a phone interview. The phone interview will take approximately 30-40 minutes and will be done at your convenience. The interview will focus the process of educating athletic training students about sudden death scenarios and the knowledge that is gained/retained. All phone interviews will be recorded with a digital recorder and will be transcribed verbatim immediately following the interview. Upon completion, you will be sent a copy of your transcription, for review and approval via email. Email is not a secure mode of transmission, therefore, if you decide against email; we can mail a copy of the transcription for approval. If you make any changes, to the interview transcript please return the updated transcript to the researcher.

What are the risks or inconveniences of the study?

The risks are minimal for this study and include the potential for the participant to be identified once the results of the study are published. To minimize this risk, all participants who participate in the phone interviews will be identified by a pseudonym, which will be assigned at the outset of the study. Additionally, any identifiers (institution, etc.) will be disguised. All digital recordings will be deleted and all transcriptions will be kept on the PI and student researchers' computers, while any paper copy will be destroyed upon completion of data analysis. Only the investigators, peer reviewers, student researchers, and members of the research team will have access to the transcripts and only the assigned pseudonym will be known to the research team and peer reviewers (student researchers and primary investigators will know identity).

The only inconvenience will be the time that it takes to complete the interview and will last approximately 30-45 minutes.

What are the benefits of the study?

You may not directly benefit from this research; however, your participation can help provide insight regarding how athletic trainers are taught to deal with sudden death scenarios. With this new knowledge we can reduce the potential for sudden death occurrences and assure that it is handled appropriately if a situation does occur.

Will I receive payment for participation? Are there costs to participate?

There are no costs and you will not be paid to be in this study.

How will my personal information be protected?

The following procedures will be used to protect the confidentiality of your data. The researchers will keep all study records (including any codes to your data) in a secure location. The code will be derived from the pseudonym that you give us at the outset of the study. All electronic files (e.g., database, spreadsheet, etc.) containing identifiable information will be password protected. Only the members of the research staff will have access to the passwords. Data that will be shared with others will be coded as described above to help protect your identity. All interviews will be recorded, transcribed verbatim, and deleted once transcription is complete. All transcripts will be electronically and stored on the PI and Co-PI's computer. Only the researchers involved in the study will have access to the transcripts, which will be destroyed upon completion of data analysis. All names will be pseudonyms. At the conclusion of this study, the researchers may publish their findings. Information will be presented in summary format and you will not be identified in any publications or presentations.

You should also know that the UConn Institutional Review Board (IRB) and the Office of Research Compliance may inspect study records as part of its auditing program, but these reviews will only focus on the researchers and not on your responses or involvement. The IRB is a group of people who review research studies to protect the rights and welfare of research participants.

Can I stop being in the study and what are my rights?

You do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate. For the background questionnaire and over-the-phone interview, you do not have to answer any question that you do not want to answer.

Whom do I contact if I have questions about the study?

Take as long as you like before you make a decision. We will be happy to answer any question you have about this study. If you have further questions about this study or if you have a research-related problem, you may contact the principal investigator, Stephanie Mazerolle, PhD at 860-486-4536 or the student researchers, Anthony Salvatore or Tom Yabor at 860-486-6353. If you have any questions concerning your rights as a research participant, you may contact the University of Connecticut Institutional Review Board (IRB) at 860-486-8802."]

Documentation of Consent:

I have read this form and decided that I will participate in the project described above. Its general purposes, the particulars of involvement and possible risks and inconveniences have been explained to my satisfaction. I understand that I can withdraw at any time. My signature also indicates that I have received a copy of this consent form.

Participant Signature:	Print Name:	Date:
Signature of Person Obtaining Consent	Print Name:	Date:

APPENDIX C

Student Questionnaire

1. Gender: **Male ____ Female ____**

2. How old are you? ____

3. Has athletic training always been your major of study? **Yes ____ No____**

If no, what was your original major? ____

4. How many credit hours are spent in class on sudden death and emergency procedures?

0 credit hours___ 1-2 credit hours___ 3+ credit hours___

5. How important do you think it is for certified athletic trainers to be proficient in diagnosing cases in which sudden death may occur?

Not important 0 1 2 3 4 5 6 7 8 9 Very important

6. Do you know the top 10 reasons for sudden death in athletes?

Yes, all 10 ____ Yes, but not all of them ____ No ____

7. How comfortable do you feel in dealing with a case where sudden death is suspected?

Not comfortable at all 0 1 2 3 4 5 6 7 8 9 Very comfortable

8. In any of your clinical rotations have you or you ACI ever suspected a pathology where sudden death could have resulted? **Yes ___ No ___**

If so, please specify (include sport, level of competition and diagnosis suspected, along actions taken)

____

____

____

9. Do you know the chain of command at your clinical site? Yes ___ No ___

If so, what is it? ____

APPENDIX D

Interview Guide

1. How often did you cover topics on sudden death in athletics/emergency planning?
    a. Probe: Did you cover it more than once in a class or just once?
    b. Probe: Was it covered in class and clinical or just one or both?
2. In what classes did you cover sudden death in athletics and/or emergency planning?
3. What conditions/concepts were covered most often during this time?
4. Can you describe the types of instructional methods used (i.e. lecture, lab, etc.) to deliver the content related to sudden death in sport?
    a. Probe: Did you have hands on time to practice the skills related to preventing sudden death in sport?
5. In what ways did your instructors try to promote critical thinking regarding preventing sudden death in sport?
    a. Probe: PBLs or simulations
6. How did you gain real-time exposure to emergency care and sudden death?
    a. Probe: Did you have any real-time exposure to providing emergency medical care (for example, did you ever see an EHS, or spineboarding, etc.)
7. Could you describe any differences that you may have experienced or seen regarding the knowledge learned in the classroom versus the clinical implementation? Explain.
    a. Probe: Could you explain how much your clinical ACI lets you participate in these evaluations/treatments, and what you think you could do to be able to participate more?
8. You are about to enter the profession as an athletic trainer; do you feel adequately prepared to manage a case of potential sudden death? Explain.
    a. Probe: what could be done to change your response?
    b. Probe: what factors influenced your response to the question?
9. Do you feel prepared to prevent liability against you at as AT regarding a potential case of sudden death?